

INFORMATION REPORT INFORMATION REPORT

CENTRAL INTELLIGENCE AGENCY

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S-E-C-R-E-T

50X1-HUM

COUNTRY USSR

REPORT

- SUBJECT**
1. One Chapter and a Collection of Figures of Handbook on T-54 Tank
 2. Document on Tank Operating Instructions
 3. Document on Diving Suit TU-1

DATE DISTR. 19 January 1961

NO. PAGES 1

REFERENCES RD

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DATE OF
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DATE ACQ.

- Att. No. 1: Chapter 12 of the handbook on the T-54 tank described in referenced reports. The chapter is entitled "A Summary of Tank Technical Maintenance Tasks," and consists of sections one to four, which deal with quick inspection and technical servicing procedures. There are 12 pages of text in all.
- Att. No. 2: An untitled collection of figures numbered consecutively from 1 to 35. Three unnumbered figures are included; figures numbered 4, 12, 23, 25, 26, 27, and 34 are not included. The figures pertain to various operating systems of the tank, including the heating, cooling, fuel, lubricating, transmission, communications, and fire fighting systems. The "main electrical equipment plan" is included among the unnumbered figures.
- Att. No. 3: Document "D", which is entitled "Brief Instruction on Operating Tanks." It has eight sections which deal with engine operation; tank maintenance under normal and under winter conditions; maintenance of fire fighting equipment and of hydraulic shock absorbers; structure, use, and maintenance of electric drive EPV-4; adjustment of driving gear; and operating arrangements and instructions both on armament and on the engine. In translated form the document is 67 pages long.
- Att. No. 4: Document "H" which is entitled "Instructions for Using the Diving Suit TU-1," and consists of two pages of text and a 50X1-HUM drawing of the suit.

STATE	X ARMY	X NAVY	X AIR	X NSA	X FBI	NIC	X	OC	X
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(Note: Washington distribution indicated by "X"; Field distribution by "#".)

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CHAPTER 12 - A SUMMARY OF TANK TECHNICAL MAINTENANCE TASKS 50X1-HUMSec. 1. The Quick Inspection. 50X1-HUM

The Quick Inspection is carried out before the tank leaves the tank park and during short halts on the road. It is done to check the vehicle's road worthiness.

(a) Before Departure

TASK	TOOLS OR EQUIPMENT REQUIRED	INSTRUCTIONS
<u>CHECK</u>		
that the tank is filled up with diesel fuel, oil water and coolant.	diesel fuel; oil M-16R; coolant.	The air supply valve must be fully closed; the filler cap must be securely fastened.
that the hatch covers and the plug in the floor of the tank are fitted properly.	-	The small hatch underneath the pre-heater exhaust pipe must be fully closed.
that the spare parts kit and other equipment on the outside of the tank are properly fitted and securely fastened (e.g. fuel tanks, tarpaulins, spare track links, towing hawser, and other accessories).	-	If necessary secure spare parts and stores.
that the gun elevating gear and turret traverse mechanism are functioning correctly.	-	
the working of the electrical firing gear both for the main armament and the co-axial M.G.; see that the lamps are serviceable.	-	
the condition of the sights and the other observation instruments.	-	If necessary, clean object lenses.
that the covers protecting instruments, assemblies and sub-assemblies are secure.	-	
that the ammunition scale is correct; that the ammunition is serviceable and correctly stowed.	-	Correct stowage of ammunition is essential.
that the wireless set and inter-com system are working (check also the buzzer call)	-	Set set on operational frequency; insert quartz block (crystal) on operational frequency and reserve frequency; check internal and external communications.
the lights - internal and external	-	Do this by switching them on and off.
start up the engine and check its performance at different speeds (low, medium, and fast running); check the controls; check for leaks.	-	Before starting up actuate the electric oil pump. In cold weather warm the engine with the pre-heater.
		/Check

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TASK	TOOLS OR EQPT REQUIRED	INSTRUCTIONS
Check the state of the batteries and resistance of the circuit by means of a voltammeter.	-	
Check the steering mechanism and the devise for opening the engine louvres.	-	Steering levers should move freely.
(b) <u>During Short Halts</u>		
Check that there are no fuel, oil or coolant leaks from the engine or oil leaks from the transmission.	-	To do this the (water) radiator should be raised.
Externally, check for possible leaks from the steering clutch case, for signs of undue wear on the road wheels and driving sprockets; also for leakages from the shock absorbers.	-	Trace leaks and eliminate.
Check that spare parts and stores are secure.	-	
Check the track tension; if necessary adjust.	-	

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Technical Servicing No. 1 is carried out each time the vehicle returns from a run irrespective of the number of kilometres covered. Alternatively it should be performed after each 100 or 150 kms. The object of servicing is to prepare the tank for future use by carrying out the tasks as set out in the servicing schedule.

TASK	TOOLS OR EQPT REQUIRED	INSTRUCTIONS
Top up tank with fuel, oil and coolant.	Diesel fuel; oil MT-16P; coolant.	When filling the radiator with anti-freeze the two top rows of radiators must be uncovered, so that the liquid can be seen entering the radiator neck. When filling up with water, the water level should reach up to the commencement of the threads in the neck of the radiator.
Clean out the holes in the fuel tank filler caps. When the tank has been operating in dust-cloud conditions wash the caps (and their float mechanisms) with diesel fuel; also remove water radiator filler caps and remove dust and dirt by washing with water.	-	
Wash the tank down; check for damage - have defects put right.	-	
Check that all hatch covers close properly, that the plug in the base of the tank is firm in its seating and particularly that there is the right amount of tension on the bolt securing the hatch covers of the emergency exit.	-	The tension may be tested with a hammer.
Check the spare parts, stores and fuel tanks for state and security.	-	If necessary tighten securing straps.
Check stowage of ammunition and ammunition trays.		
Tracks and Suspension		
Examine the tracks, look for defects in the tracks and track pins; if necessary correct track tension.	-	-

When, as the result of wear, it is no longer possible to take up slack in the tracks by means of the track tensioner, one link should be removed from each track. When three links have been removed from each track change the left sprocket round with the right one and renew all track pins. After this, remove more links, but when six or seven links have been removed and further tightening is impossible, change the tracks.

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<p>Check that there are no oil leaks from the labyrinth formation covers, (fluid seal preventing leakage of fluid between moving parts), or from the armoured hub-covers of the road wheels or idler wheels; check also there is no escape of fluid from the shock absorbers.</p>		<p>At the same time ensure that grease nipples are clean and not "clogged".</p>
<p><u>Engine Compartment</u></p>		
<p>Remove dust and dirt and examine for defects.</p>	-	<p>Remove any foreign bodies.</p>
<p>Examine the engine and the various engine components for oil and coolant leaks; pay particular attention to joints and unions.</p>	-	<p>Should an oil leak be found in any assembly, check the oil level and where necessary top up; rectify the fault.</p>
<p>Check that the arrows coincide which show whether or not the brake bands on the transmission brakes are properly adjusted.</p>	-	<p>The arrows will coincide when the brake bands bear evenly against the surface of the brake drums. Permissible error between the arrows is 3 mm.</p>

When the tank is being driven in extremely dusty conditions and it is found that greater effort is needed to move the epicyclic gear levers and gear box, wash out the couplings and needle bearings of the steering mechanism with diesel fuel. Do not oil the couplings after washing out.

Clean out air cleaner.	-	See section: "Maintenance of the air supply system".
------------------------	---	--

Fighting Compartment

<p>Clean the compartment of dust and dirt. Check ease of opening and closing and fit of turret hatches of the driver-mechanic, commander and loader, and the latches and clamps on them.</p>	<p>Oil Tsiatin-201</p>	<p>If necessary clean and oil the opening devices.</p>
--	----------------------------	--

In conditions of high temperature and dusty air the closing devices should be covered with a thin layer of gun oil.

<p>Check ease of turning of the turret (the horizontal laying handwheel of the gun) using the hand or electrical gear, and ease of turning of the vertical laying handwheel of the gun.</p>	<p>Oil Tsiatin-201 Diesel oil.</p>	<p>If turret turns stiffly, wash out the turret bearing race: if handwheels are stiff, clean wash out and oil the teeth of the driving gears of the elevating and traversing mechanisms and the elevating arc.</p>
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In hot temperatures and dusty conditions cover the teeth of the gears and the arc with a thin layer of gun oil.

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Clean of dust or mud the contact device on the commander's hatch and the contact device of the turret traverse mechanism.

-

In very dusty conditions clean with a rag the contact rings and brushes of the commander's hatch and turret traverse mechanism contact device.

Check ease of turning of the vertical laying handwheel of the DShK MG.

Oil Tsiatim
201 or UTM
oil.
Diesel fuel.

If tight, clean the teeth of the gear and arc on the cradle with a rag soaked in diesel oil: then oil up.

In hot temperatures and dusty conditions cover the teeth of the gear and the arc on the cradle with a thin layer of gun oil.

Check:

- Operation of the electrical firing mechanism of the gun and MGs; ensure first that the gun and MGs are unloaded, and having cocked the striker mechanism and the AAGs, fire the gun and MGs by pressure on the appropriate firing button.

-

In hot temperatures and dust clean the firing buttons of the co-axial MG using an air spray.

- Condition and firmness of sights and observation instruments.

-

If necessary clean the glasses.

- Operation of lighting systems for the sight scales and tank interior, and turret and hull fans.

-

Check by switching on.

On completion of a move with uncovered gun barrel, check chamber and bore of the gun and also the condition of the MG armament.

If necessary clean and oil the gun and MGs.

Driver's Compartment

Clean out the driver's compartment.

Check:

- air pressure in the cylinders, and ensure that there are no leaks from the compressed air starter system.

If air pressure in summer is less than 45 kg/cm² or in winter less than 65 kg/cm², charge the cylinders to 150 kg/cm².

Translator's Note. 1. This would seem to correspond to a rotary base junction as described in the Centurion Manual.

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- ease of opening and closing of the louvres, by moving the levers from the fully closed to the fully open position and back.	Oil US (solidol) or oil MT-16P.	If hinges stick, correct and oil the hinges.
- operation of the warning lamps and alarm horn of the fire-fighting system, by pressing the lamp test button on the warning board.	-	The lamps should light up and the horn sound.
- external signal (?) and internal lighting arrangements, and also operation of the head lights and side lights.	-	Before testing, clean the external parts of the head lights and side lights of dust: clean the glasses without removing them. The external signal must <u>not</u> be cleaned by a jet of water under pressure.
Remove the driver's episcopes from their seatings, and if necessary clean them: clean the surfaces of the seatings of dust or mud and lightly oil.	Summer: gun oil or solidol: winter half and half mixture of gun oil and MT-16P.	In hot temperatures and extreme dust do not oil the episcopes or seating after cleaning.
Check battery clamps on the racks and leads to output terminals (externally). Clean terminals of mud and lightly oil.	Industrial vaseline or solidol.	In summer, at temperatures of more than + 30°C - every 5-6 days, and otherwise every 10-15 days, check level of electrolyte, ensure there are no leaks, and check degree of charge by density of the electrolyte and if necessary with a heavy discharge battery cell tester.
If when moving the engine does not work normally, "rev up" and test the operation of the engine by ear and with instruments at different engine speeds. Remedy any faults.	-	When the crank shaft is turned by the starter, the voltmeter should record a tension of 17-18 volts.

When leaving the tank, switch off all electrical apparatus and the battery cut-off switch.

If the tank has to be left standing for more than 24 hours, change round the tap on the fuel distribution box.

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Sec. 3. Technical Servicing No. 2.

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Technical Servicing No. 2 is carried out every 1000 km. in order to check the technical condition of the tank and to prepare it for future running: the following schedule if carried out.

TASK	TOOLS OR MATERIALS REQUIRED	INSTRUCTIONS
Carry out all tasks as laid down in Technical Servicing No. 1, and in addition:-		
Check:-		
- spare parts kit in the tank, and its fastenings.	-	
- tightness of bolts on the removable part of the engine compartment hatch.	-	If necessary tighten the bolts and change any cross-threaded ones.
Tracks and Suspension		
Check:		
- tightness of bolts on the idlers, road wheel brackets, driving sprockets and hydraulic shock absorbers, and also fastenings of the final drive covers to the hull.	-	Carry out the check by knocking off the nuts with a hammer so that access may be obtained without dismantling sub-assemblies.
- tightness of bolts attaching driving sprockets to the driving shafts of the final drive.		No play can be allowed.
Condition of the rubber tyres on the bogey wheels.	-	-
Engine Compartment		
Change the oil in the engine lubrication system.	Oil MT-16P	In hot dusty weather when changing the oil wash out the system with hot oil MT-16P.
Wash out:		
- the inlet filter of the oil tank.	Diesel Oil.	
- the oil filter KIMAF-STL	Diesel Oil.	Change cardboard filter elements every 2000 km.
- the "rough filter" for the fuel.		
- the gauze and openings in the delivery tube of the fuel pump.		After washing out, wipe dry.
Check:		
Firmness and condition of exhaust manifolds and tubes and their connections to each other.		Carry out check without dismantling sub-assemblies.

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- firmness of control instruments bolts.	-	
condition of the fans and their levers, firmness and split-pins of the fan bolts, toothed couplings, casings and lever pins.	-	
- condition and firmness of toothed couplings joining gear boxes and epicyclic steering gears.	-	do not strip sub-assemblies.
- connections of the speedometer flexible tubing.	-	
- condition of the transfer gears, of the connecting toothed couplings and firmness of the bolts.	-	do not strip sub-assemblies.
- firmness of starter and starter leads.		
- condition of the brake bands of the epicyclic steering gears and their ball and socket joints, and also clearance between the brake bands and the drums.	-	clearance should be from 0.8 - 2.5 mm: if necessary adjust.
Oil:-		
- hub bearings of the fan.	Oil UT (konstalin)	Add 100-150 gms.
- the ball bearings of the clutch release unit of the main clutch and the operating clutches of the epicyclic steering gear.	Oil UT (konstalin)	Add 75-100 grams to each point. When tank is operating in loose dust regions, oil every 250-300 km.
- vertical shaft of the gear box linkage.	Oil UT (konstalin)	Add 75-100 grams.
Check the level of oil in the transfer gear case and the gear boxes if necessary top-up.	Oil MT-16P	Normal oil level in the transfer gear case is the upper mark on the dipstick by the letter 'G' - in the gear boxes, by the letter 'K'.
Oil in the gear boxes, transfer gear case, and the epicyclic steering gears is changed every 4000 km or when the sub-assemblies are stripped.		
Check firmness of the pre-heater boiler.		
After every 50 hours working of the pre-heater, clean the boiler of combustion products and add 20-30 grams of oil TSIATEM-201 to the reductor housing. In winter, when the pre-heater is in use, periodically oil the socket of the casing into which the axle of the hand-drive gear fits, with TSIATEM-201 (UTM or US). Clean out the boiler without removing it from its seating.		
- Check anti-freeze (specific gravity, percentage of ethylene glycol to water)	-	-

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Fighting Compartment**Check:**

- Turret Clamp.

- Ease of turning of commander's cupola on its ball support and the hatch hinges.

- firmness of MG mounting on the swivel mount, ease of turning and vertical laying hand-wheel of the DShK MG.

- radio set mounts and intercom system lead connections: operation of sets and intercom.

Diesel oil,
TSIATIM-201.

Diesel oil,
TSIATIM-201.

If stiff, wash out and oil.

If still (either swivel or handwheel), clean wash out and oil the swivel or teeth of the gear and arc on the cradle.

If necessary, tighten connections.

When servicing has been completed, tidy up the compartments and replace spare parts kits.

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SECRETSec. 4. Technical Servicing No. 3.

This is carried out every 2000 km with a view to checking the technical condition of the tank and preparing it for further running. The following tasks are carried out:-

All tasks as set out in Technical Servicing No. 2, plus the following:-

Inspect and if necessary clean and oil the catches of the towing hooks and the locks, hinges and articulated couplings of the hatches.	Parafin, oil MT-16P, oil US (solidol)	-
Tracks and Suspension		
Check road wheel brackets, bracket supports, shock absorbers, track tensioners, and labyrinth packings of the bogey wheels and idlers.	-	By visual external inspection.
Tightening the nut on the rod of the mushroom head of the shock absorber is carried out by screwing up until all clearances between the mating members have been removed: then make one more turn and insert split-pins.		
Check the joint pins and bushes of the hydraulic shock-absorber linkage.	-	If significantly worn, replace.
Oil the sleeves of the road wheel bracket axles.	Oil US (solidol)	Oil (100-150 grams) should be inserted in the apertures in the brackets of the road wheel brackets.
Add oil to the bearings of the bogey wheels.	Oil US (solidol)	

Changing the oil in the bogey wheels, idlers and track tensioners, and also lubrication of the rollers in the road wheel bracket supports, is carried out every 4,000 km or when these sub-assemblies are dismantled.

Engine Compartment		
Check the pressure relief valve and ease of movement of the valve plunger in its seating.	-	Remove jamming by a lateral displacement of the plunger and washing out of the valve (not dismantled) in hot water. If this is impossible, replace the whole valve assembly.
Change the cardboard filter element of the oil-filter.	-	-
Wash out the fine fuel filter.	Diesel fuel.	-
Check level of oil in the fuel pump regulator housing.	Oil MT-16P.	Change the oil every 4,000 km.
Pour 20-30 grams into the casing of the speedometer cable.	Oil MT-16P.	Pour the oil, and carefully tighten the nut on the flexible speedometer cable.

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Check end face and radial clearances between the teeth of the starter gear and the toothings of the main clutch.

-

between the ends of the teeth should be 4-5 mm. and radial clearance between the sides of the teeth - 0.8 - 1 mm.

In extremely dusty conditions, clean the commutator and brush-holder of the starter whenever it is removed, but not less than every 2000 km.

Check magnitude of moment of slipping of the fan clutch (clutch should slip at a moment of rotation of 18 to 50 kilogram/metres.

-

If the friction plates are worn to a thickness of 1 mm or less, change the driving plate of the fan clutch.

Ensure that oil is not leaking from the joint of the final drive housing and along the shaft packings, and also check the fastenings of the final drive to the hull.

-

External inspection: knock the nuts and bolts with a hammer or where accessible use a spanner.

Add to the final drives, which are filled with TSIATIM-208, .5 kg each.

TSIATIM-208

Changing oil TSIATIM-208 is carried out every 4000 km or when the final drive is dismantled.

Driver's Compartment

Oil the pedal shaft and link bracket.
Lever?

Oil UT
(Konstalin)

Add 50-75 grams at every point.

Check the electrical circuit of the fire fighting system, (when replacing cylinders) and the flame detector switches.

Check linkage adjustment of the gearbox, main clutch, epicyclic gears, brakes and fuel pump: check ball and socket joints and split-pins of the linkage bolts.

Fighting Compartment

Check firmness of upper and lower turret ball race bearings and recoil guard.

-

If necessary tighten bolts.

Clean the TPA-1 and MK-4 sights of dust, remove old oil and apply fresh (in places to be oiled).

Oil UT
(solidol)

Oil:-

- teeth of the turret traverse mechanism (electric motor)

Oil TSIATIM-201

If the traverse mechanism is stripped and oil removed from the housing, add 750-800 grams of fresh oil TSIATIM-K1.

- reservoir of the handwheel axle, teeth of the arc, and gear of the MG DShK mounting

Oil TSIATIM-201

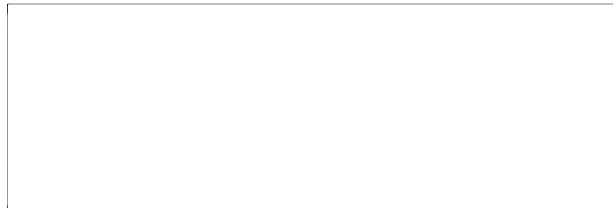
In dusty conditions cover with a thin layer

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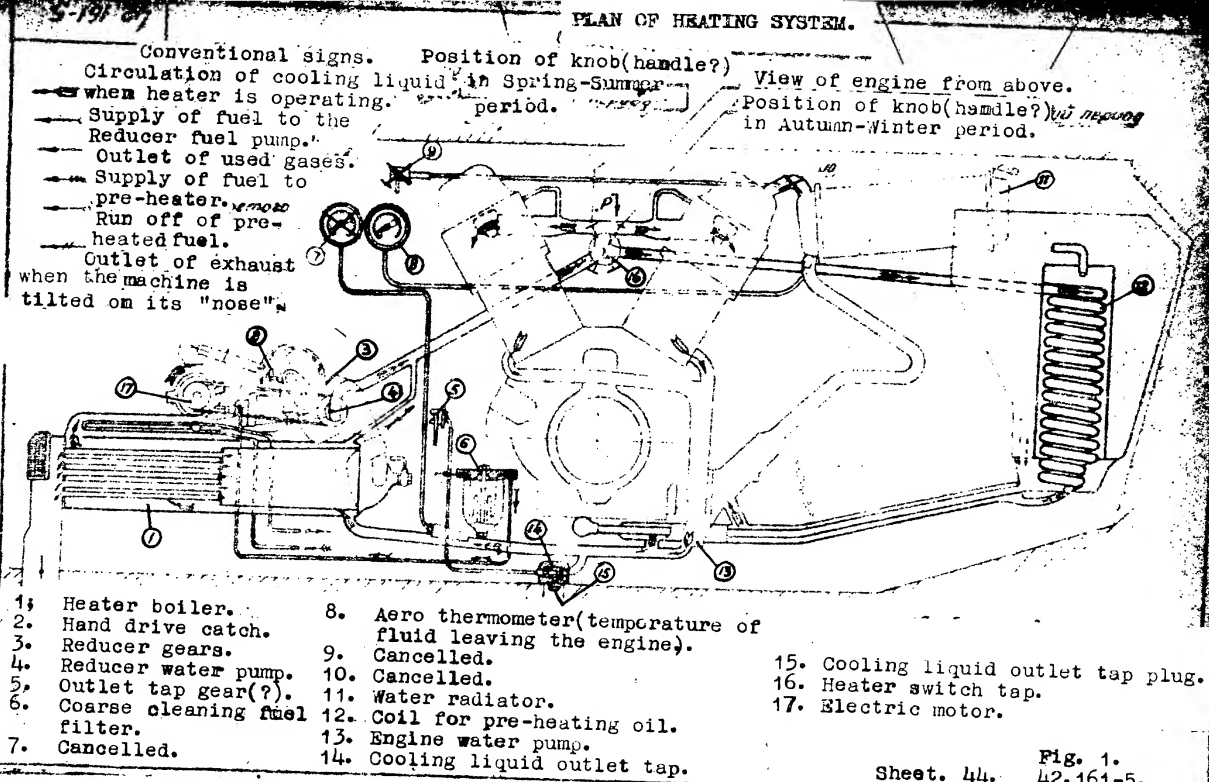
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- all leather straps on the tank should be oiled once a year with ammunition oil.		
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Sheet. 44. Fig. 1. 42.161-5.

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1. Dipstick

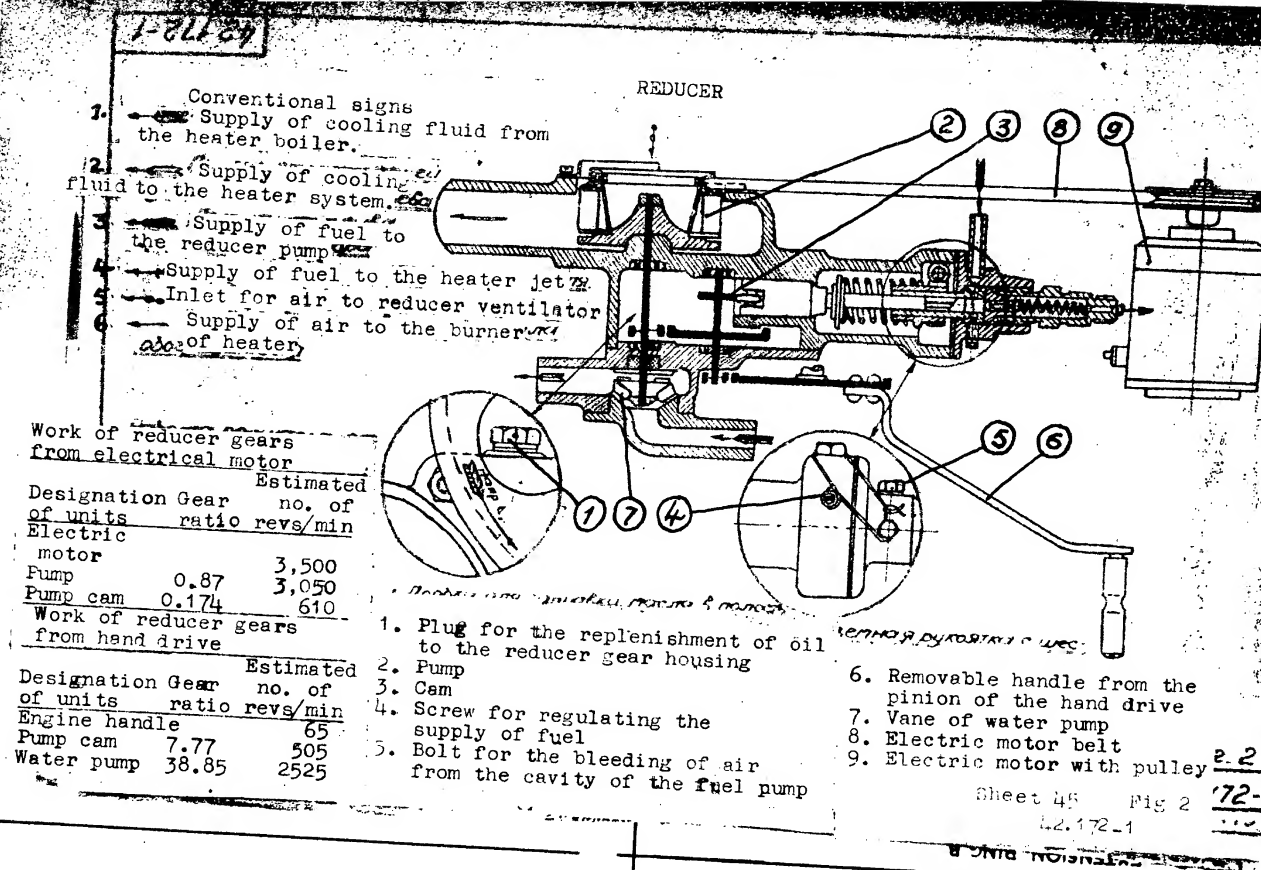
2. Oil tank

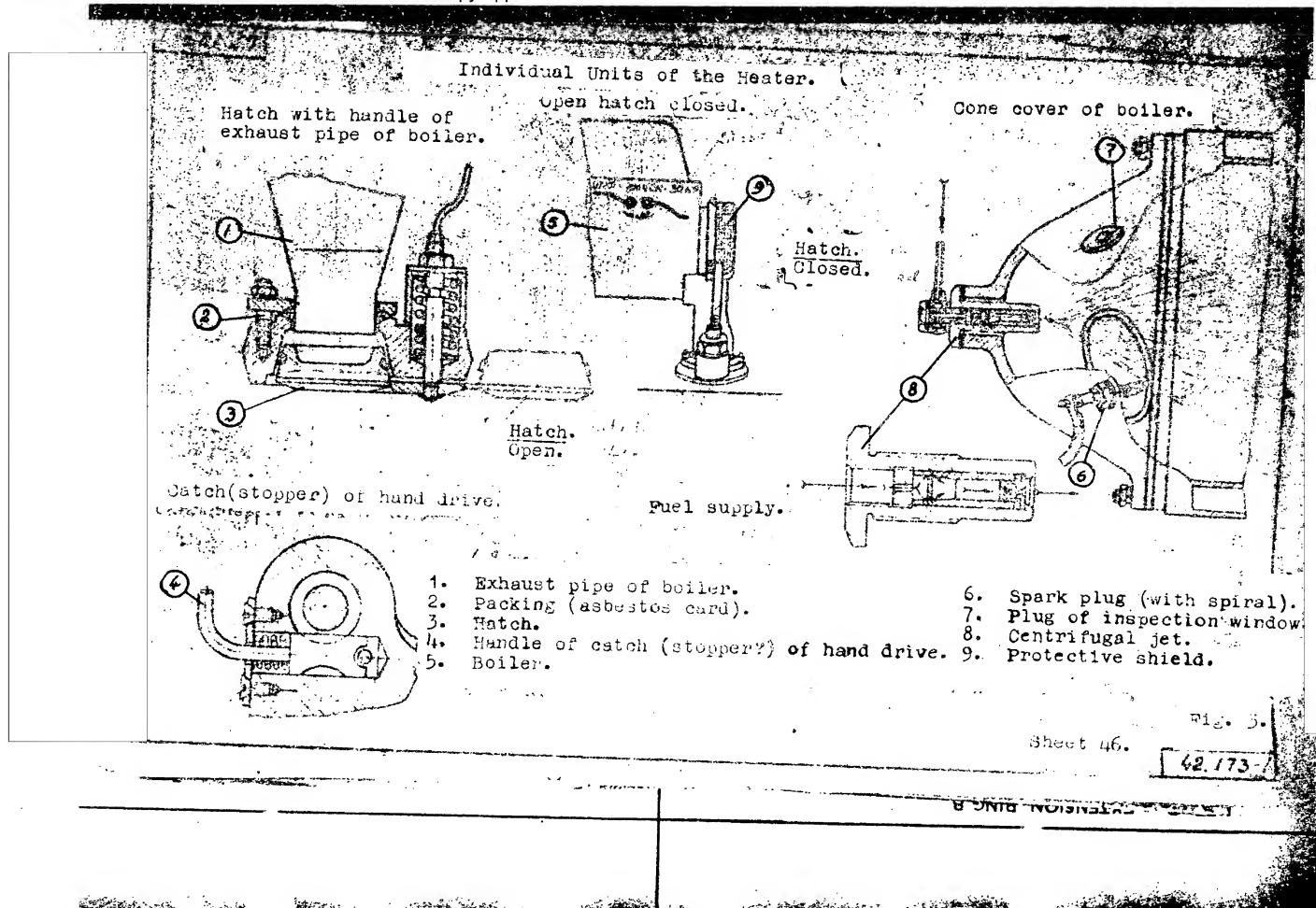
Fig 1a. Sketch of
placing the dipstick
when measuring the
oil level in the tank

Fig 1a

Fig 1a

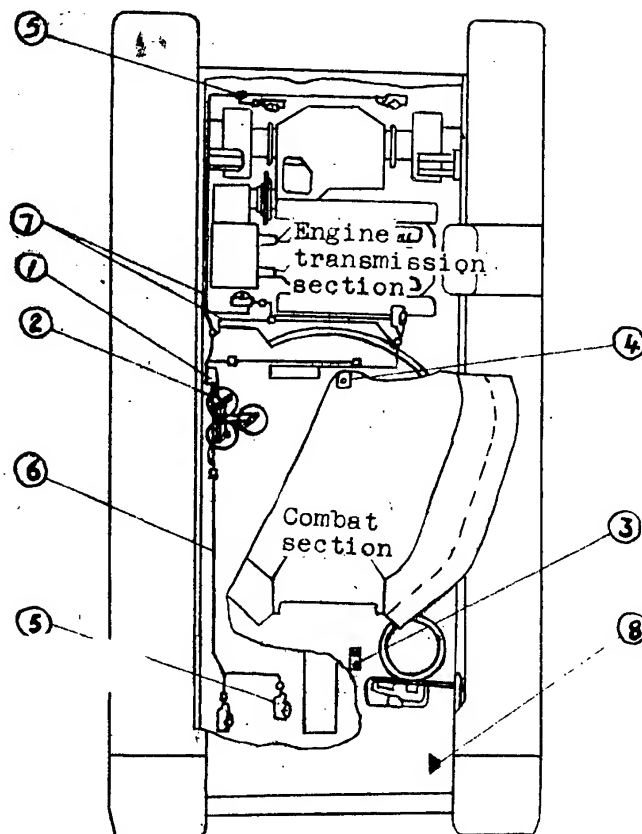
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VPT Anna Wierzbicka & John



1. Switch-meter
2. Carbonic acid extinguishers
3. Signal Board PPO with buttons for extinguishing fire in the engine-transmission and combat sections
4. PPO Commander's button (in the turret) for extinguishing fire in the combat section
5. Thermo electric alarm with outlet pipe (exhaust?)
6. Pipe leads of the combat section
7. Pipe leads of engine-transmission section
8. Signal whistle

Positioning of Fire-fighting Equipment

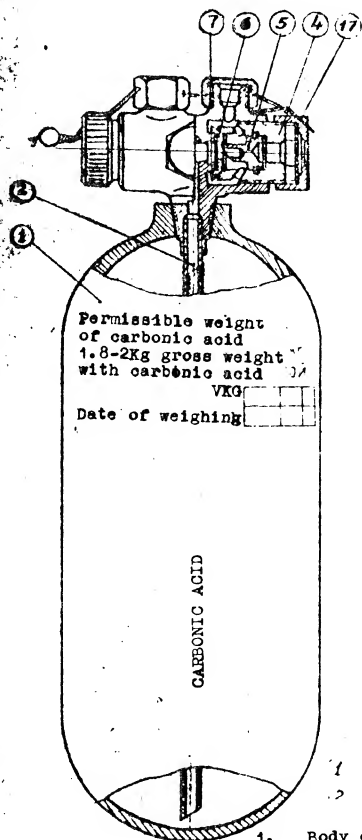
Sheet 61 Fig. 5
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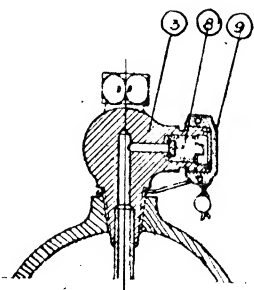
CAP ASSEMBLED FOR A COMPANY? SET CHARGING PIPE



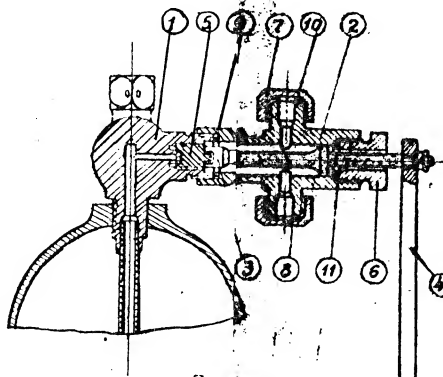
Permissible weight
of carbonic acid
1.8-2Kg gross weight
with carbonic acid
VKO
Date of weighing

CARBONIC ACID

1. Body of cap.
2. Body of spout.
3. Spout shaft.
4. Spout lower.
5. Pipe(connector?) with washer.
6. Clamping nut.



Spout for charging carbonic acid
extinguishers



1. Корпус цилиндра
2. Тело сопла

7. Стоппер(choke?).
8. Стоппер.
9. Washer.
10. Washer.
11. Washer.

1. Cylinder.
2. Siphon pipe.
3. Body of cap.
4. Plug.
5. Plunger with fixing ring and piercer.
6. Washer with membrane.
7. Stopper.
8. Pipe(connector?) with washer.
9. Stopper.
10. Cap covering nut.
11. Contact.
12. Chuck PP-3.
13. Bush(collar?).
14. Rubber collar.
15. Plug.
16. Fibre ring.
17. Fibre stopper.

CARBONIC ACID EXTINGUISHER
AND SPOUT FOR CHARGING.

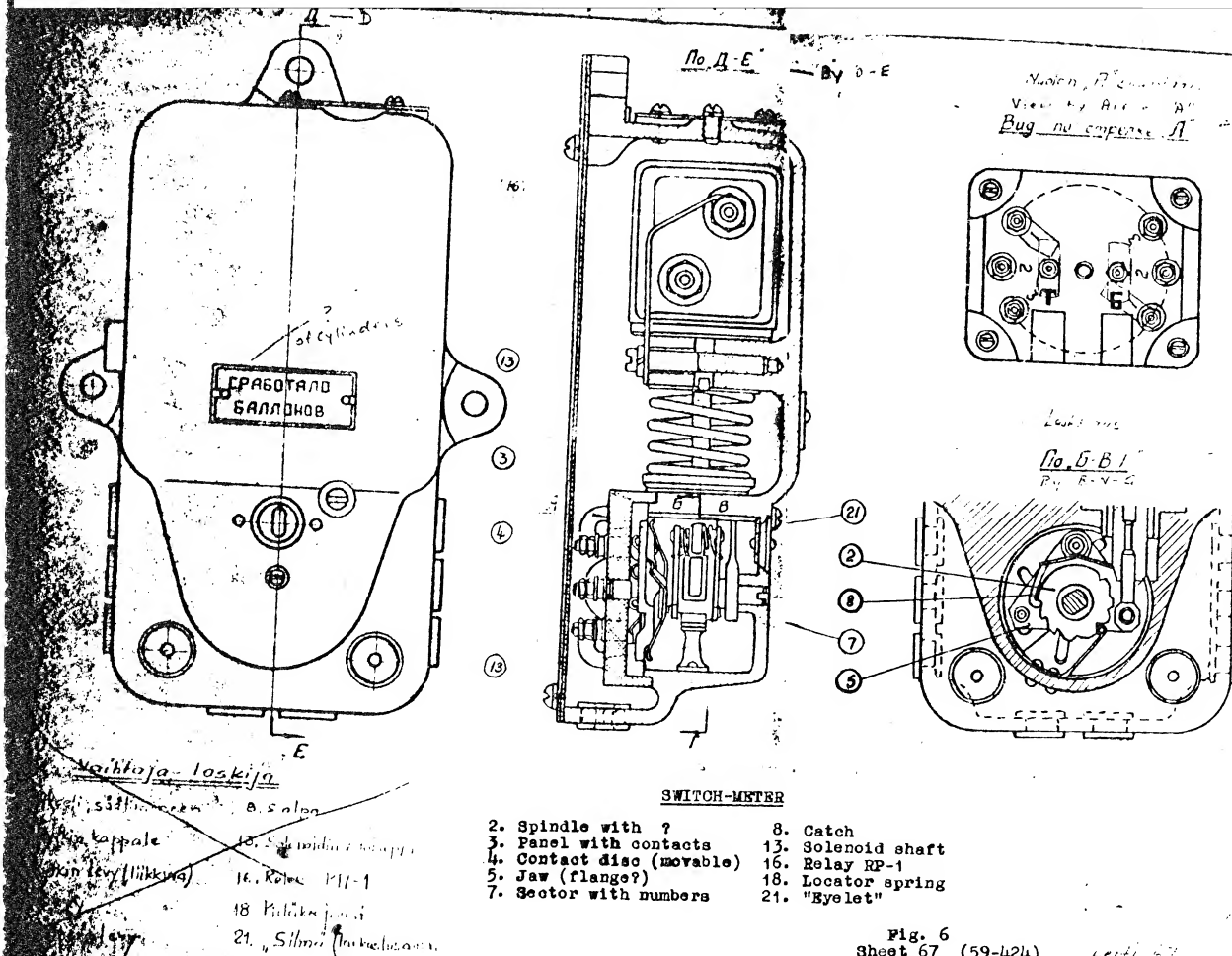
Sheet 62.

Fig. 7-
59.423.

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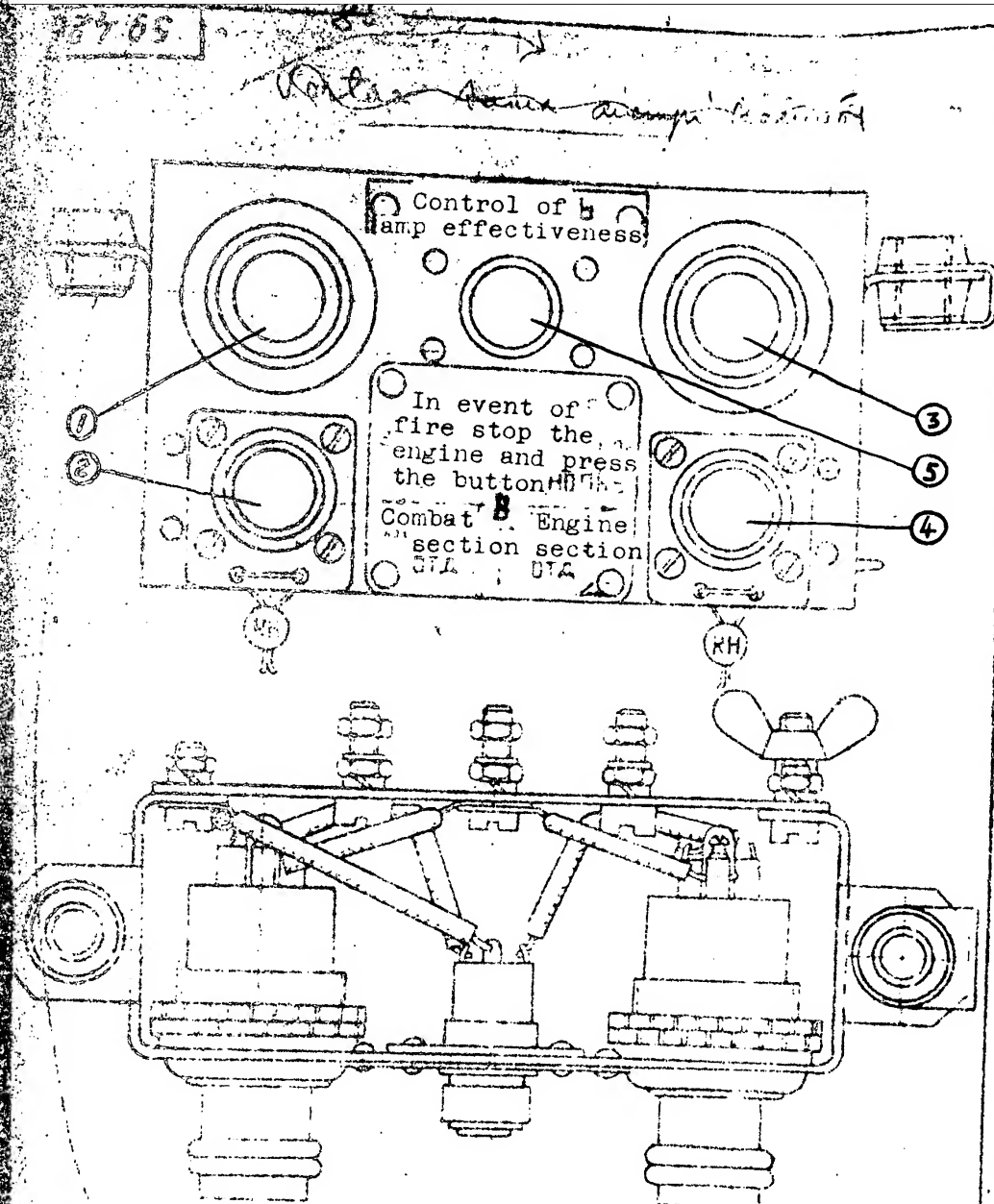
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PPO SIGNAL BOARD

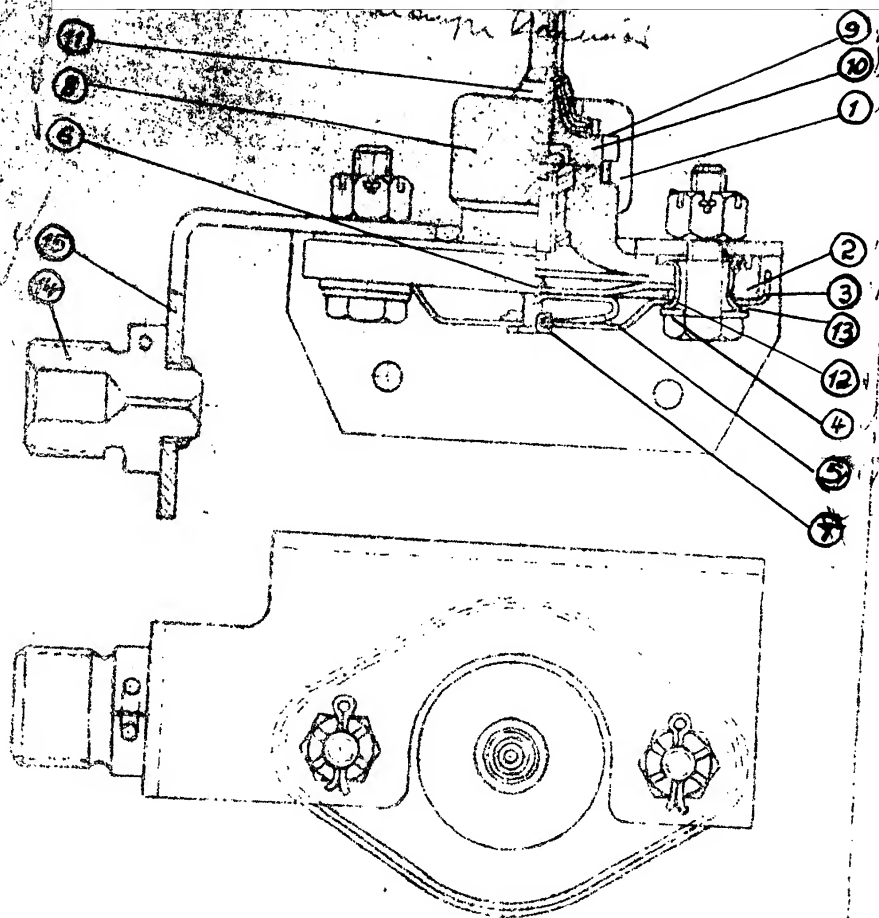
fig. 8

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- | | |
|------------------------------|-------------------------------------|
| 1. Contact screw. | 9. Lead contact. |
| 2. Body. | 10. Packer. |
| 3. Casing. | 11. Cone strengthening of braiding. |
| 4. Membrane. | 12. Ring. |
| 5. Cross piece(bridge?). | 13. Cap(piston?). |
| 6. Contact. | 14. Outlet pipe(exhaust?). |
| 7. Cross piece cap(piston?). | 15. Arm (cantilever?). |
| 8. Covering nut. | |

THERMO-ELECTRIC ALARM (notifier?) WITH
OUTLET PIPE (exhaust?).

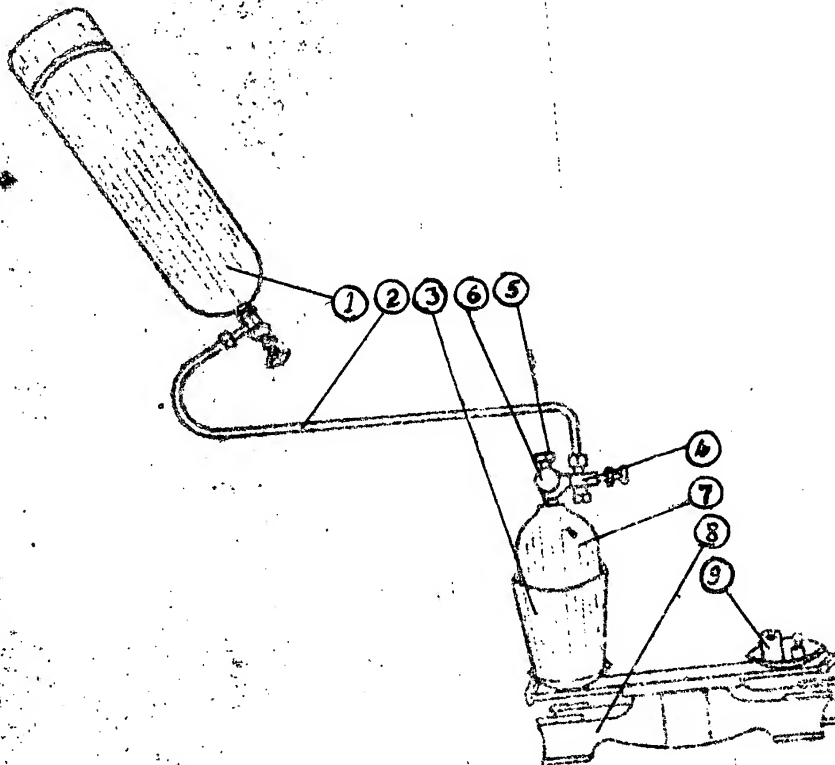
Sheet 65. Fig. 9.
59.425.

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1. Cylinder with Carbonic Acid.
2. Connecting pipe.
3. Cooling medium.
4. Charging key.
5. Stopper.
6. Body of cap.
7. Fire extinguisher.
8. Scales.
9. Weights.

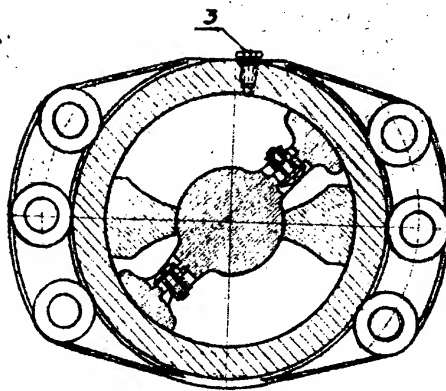
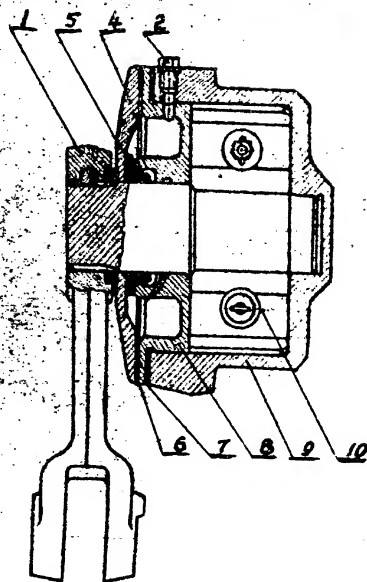
PLAN OF FIRE EXTINGUISHER CHARGING.

Sheet 74. Fig. 10.
59.427.

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1. Lever
2. Plug
3. Plug
4. Plug
5. Packing
6. Gasket
7. Gasket
8. Screen (partition)
9. Frame (could be body)
10. Fan blade

Fig. 11. Hydraulic Shock Absorber

Item 77

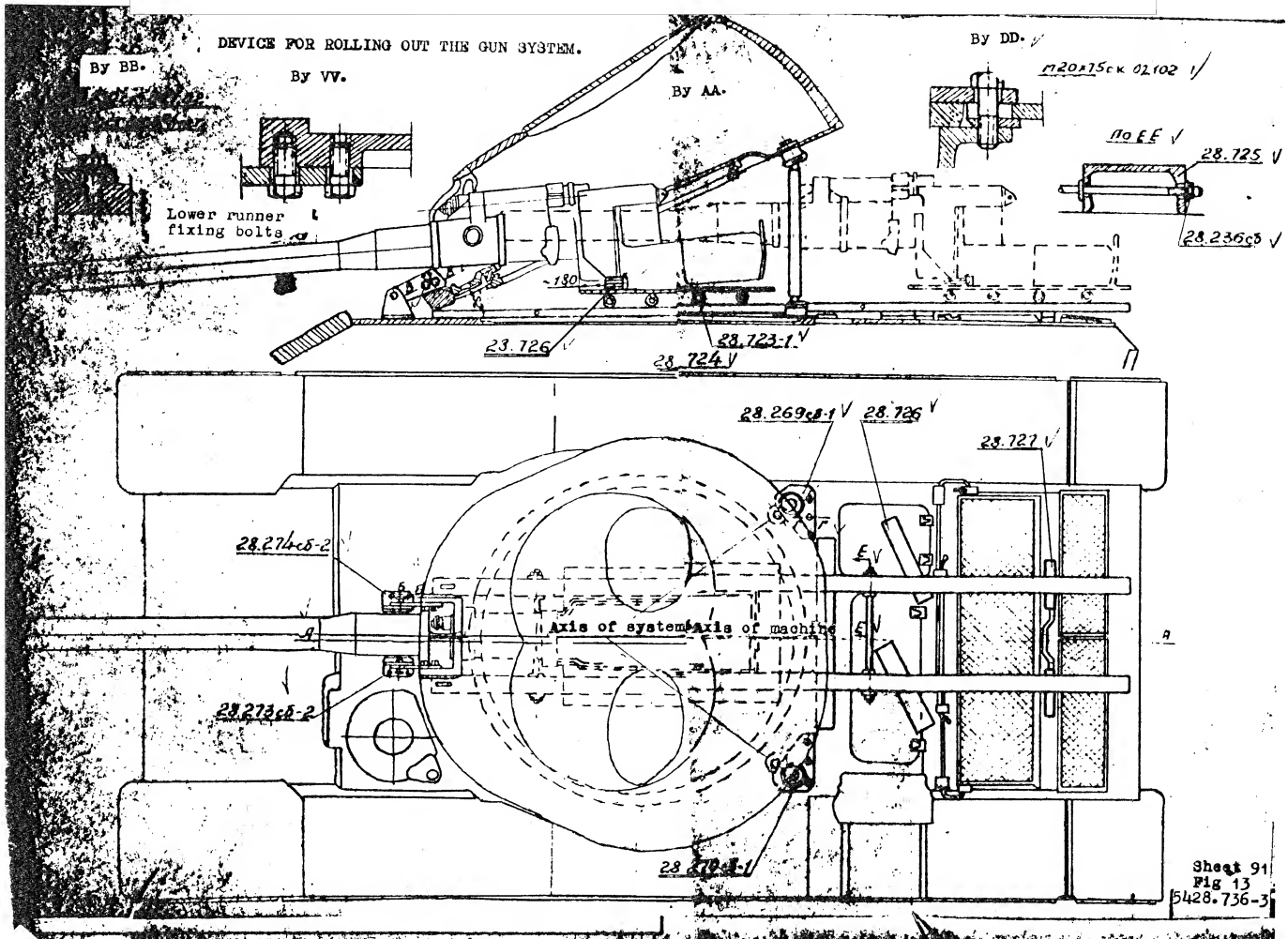
28 699-5

ON RING B

SIZE 9 EXI

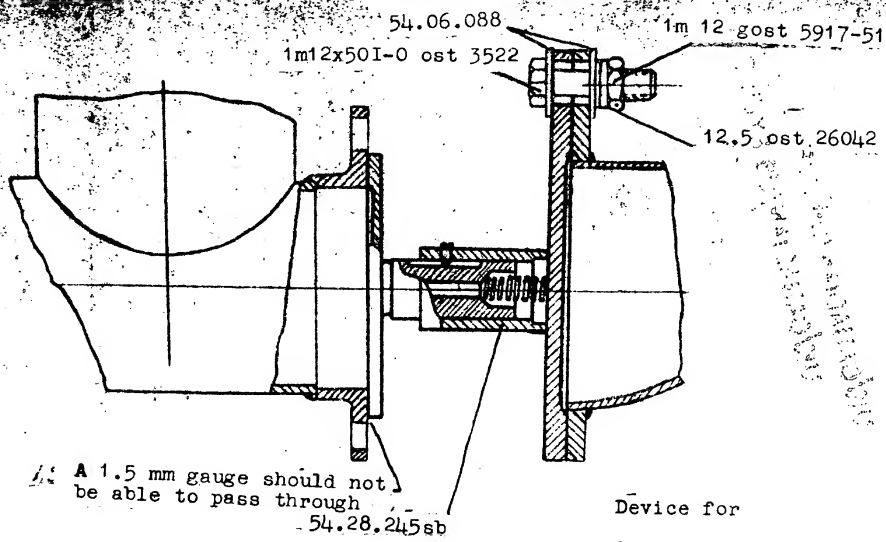
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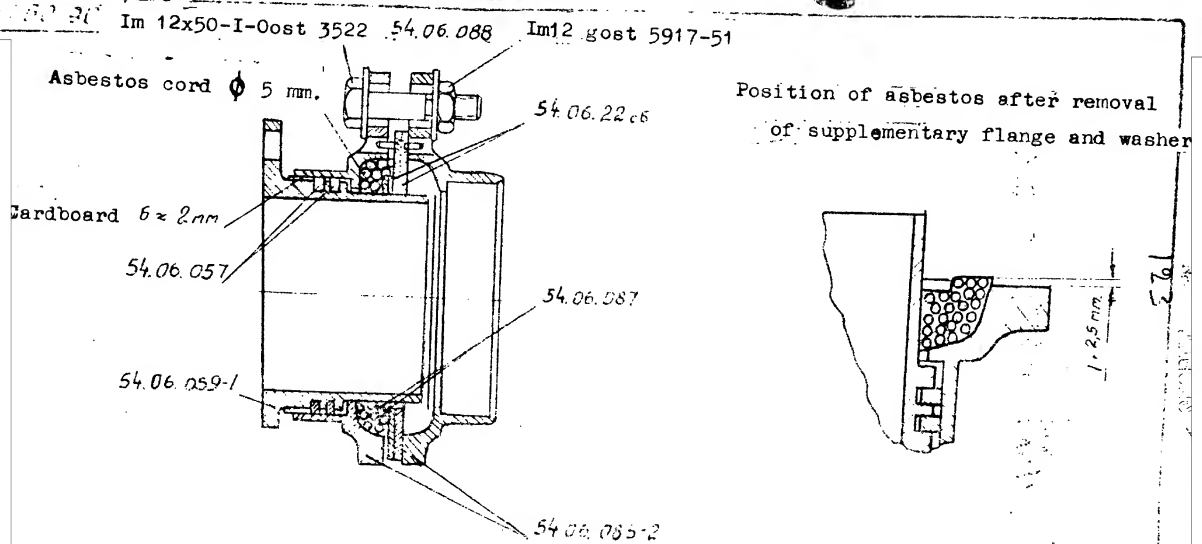
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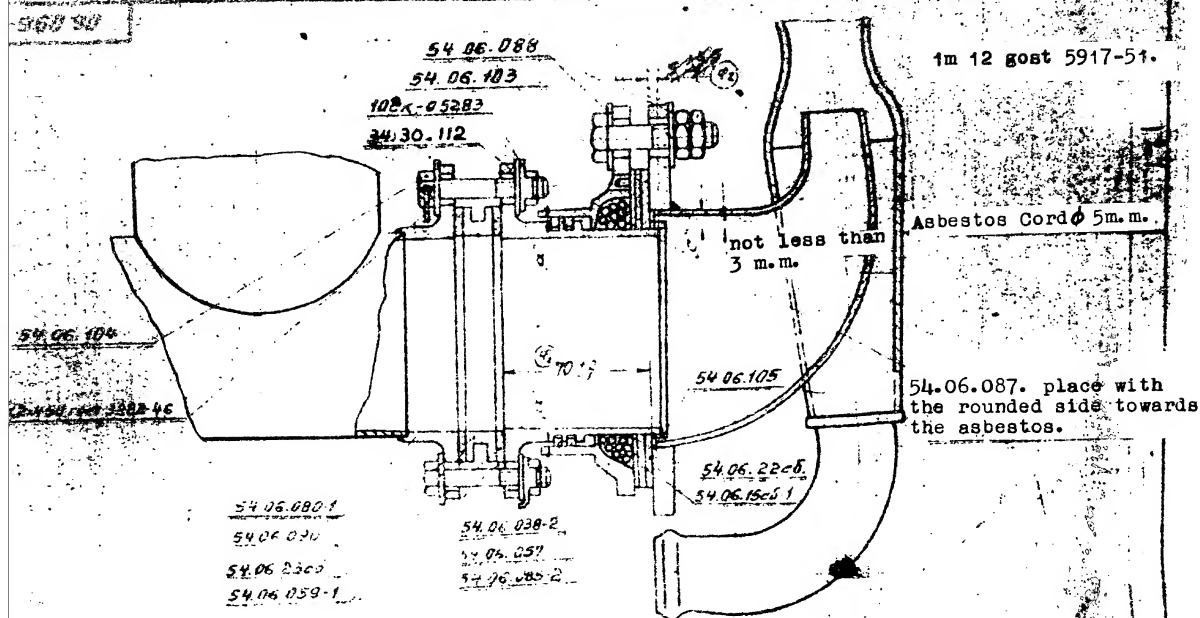
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Pressing the Asbestos Cord
into the Exhaust Packing

Fig. 15
Sheet 98 (06.097-1)

50X1-HUM



JOINING OF THE EXHAUST PIPE
WITH THE EXHAUST COLLECTOR.

Fig. 16.
Sheet 99. 06.096-2.

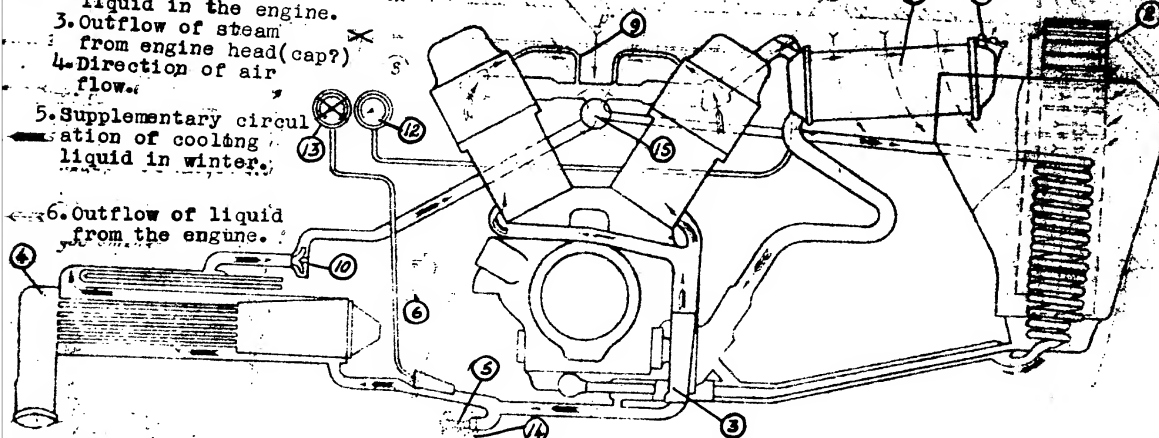
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7-162 20 75

PLAN OF COOLING SYSTEM.

Conventional signs. Position of arm View of engine in Spring-Summer from above. Position of arm in Autumn-Winter period(dotted). (connected).

1. Flow of cooling liquid to pump.
 2. Flow of cooling liquid in the engine.
 3. Outflow of steam from engine head (cap?)
 4. Direction of air flow.
 5. Supplementary circulation of cooling liquid in winter.
 6. Outflow of liquid from the engine.



Radiator.
 Ventilator.
 Engine water pump.
 Heater.
 Drain tap.
 Lead to drain tap.
 Canceled.

8. Canceled.
 9. Steam outlet pipes.
 10. Reducer water pump.
 11. Filling aperture and vapour valve.
 12. Aero thermometer checking the temperature of cooling liquid leaving the engine.

13. Canceled.
 14. Plug for supply of cooling liquid.
 15. Heater switch tap.

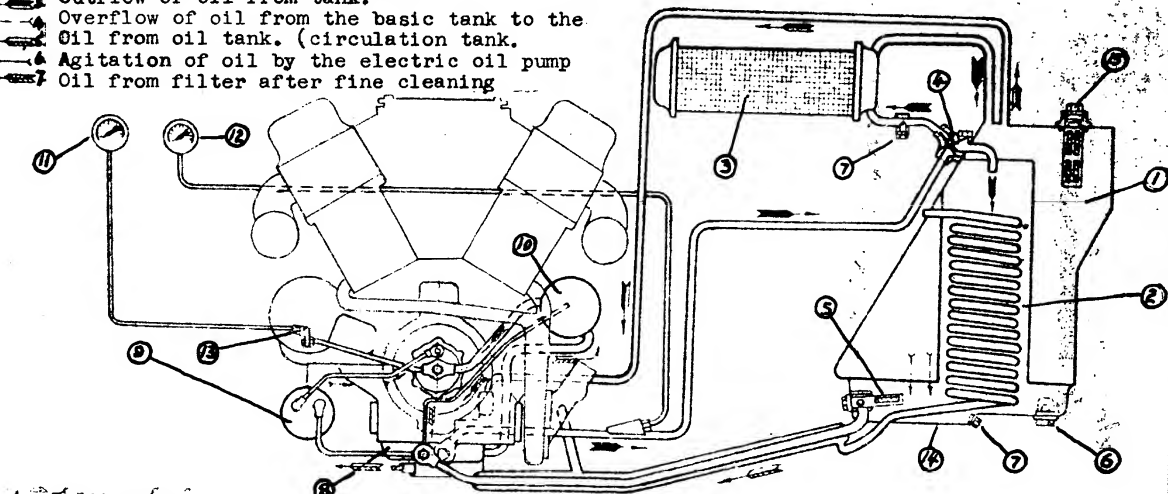
Sheet. 112. Fig. 17.
 54.02.391-2.

2-22

Plan of Lubricating System

Conventional signs

- 1. Supply of oil to the engine after (slotted?) cleaning.
- 2. Outflow of oil from the engine.
- 3. Outflow of oil from tank.
- 4. Overflow of oil from the basic tank to the
- 5. Oil from oil tank. (circulation tank).
- 6. Agitation of oil by the electric oil pump
- 7. Oil from filter after fine cleaning



- 1. Basic tank
- 2. Circulating tank (starting)
- 3. Oil radiator
- 4. Cancelled
- 5. Oil intake filter
- 6. Oil drain valve
- 7. Oil drain plug
- 8. Oil pump
- 9. Electric oil pump
- 10. Oil filter "KIMAF-ST3"
- 11. Manometer (pressure gauge)
- 12. Air thermometer
- 13. Manometer receiver
- 14. Sump
- 15. Oil filler plug

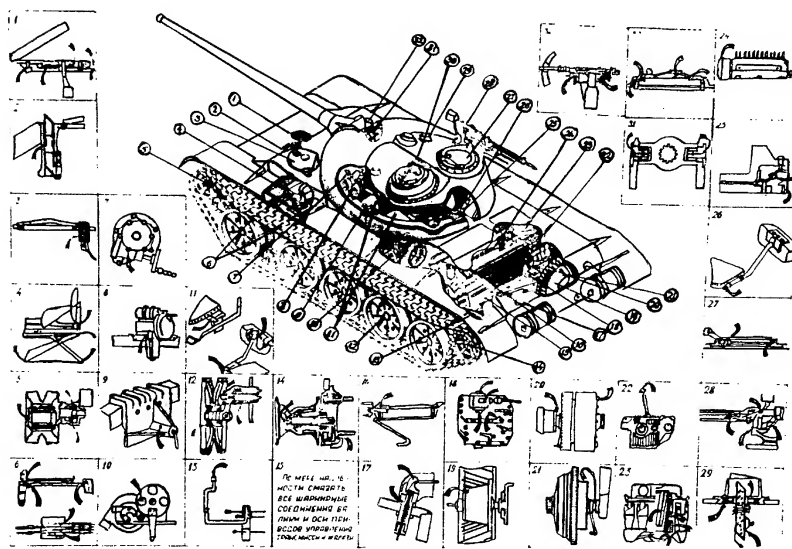
Fig. 18
Sheet 113 (03.177-2)

Фур. 18

03.177-2

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50X1-HUM



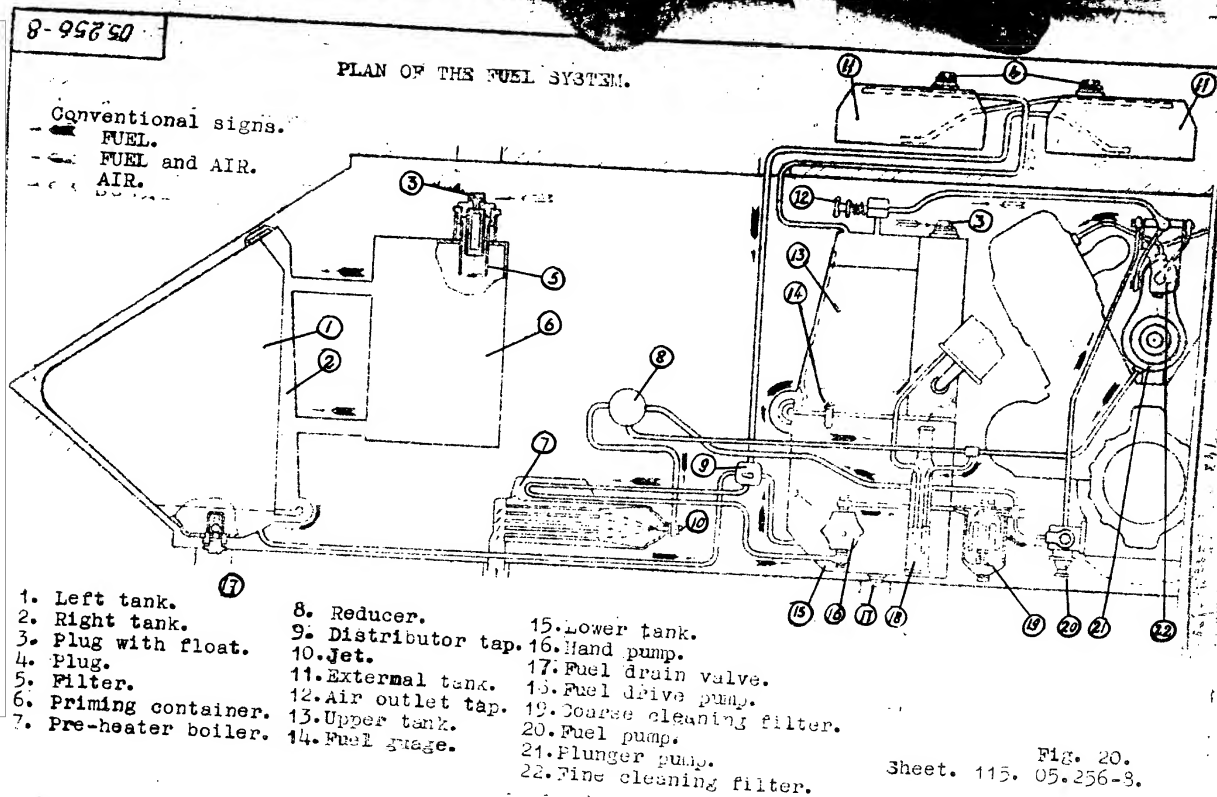
LUBRICATION CHART.

15. As far as is necessary lubricate all hinge joints, shafts and axes of driving gear transmission and louvres.

Fig. 19

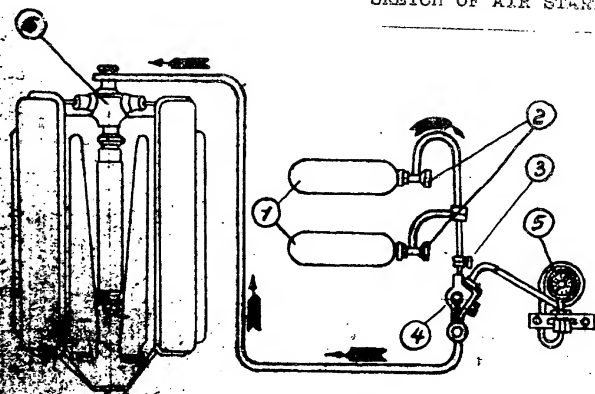
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1-920'8E

SKETCH OF AIR STARTER SYSTEM



Conventional signs
 ← Movement of air

1. Cylinder for compressed air of 5 litres
2. Cylinder valve
3. Connecting pipe for charging the cylinder
4. Reduction tap
5. Manometer (Pressure gauge?)
6. Air distributor of diesel motor

Attention!

1. Only use the air starter in the event of a fault in the electric starter.
2. Economise with air by:
 - a) Before starting open the valve to the full.
 - b) Before starting, sharply open and close the reduction tap.
 - c) After starting keep the valve and tap shut
 - d) Do not permit wastage of air through defects in joints.

Fig. 21 (38.036-1)

50X1-HUM



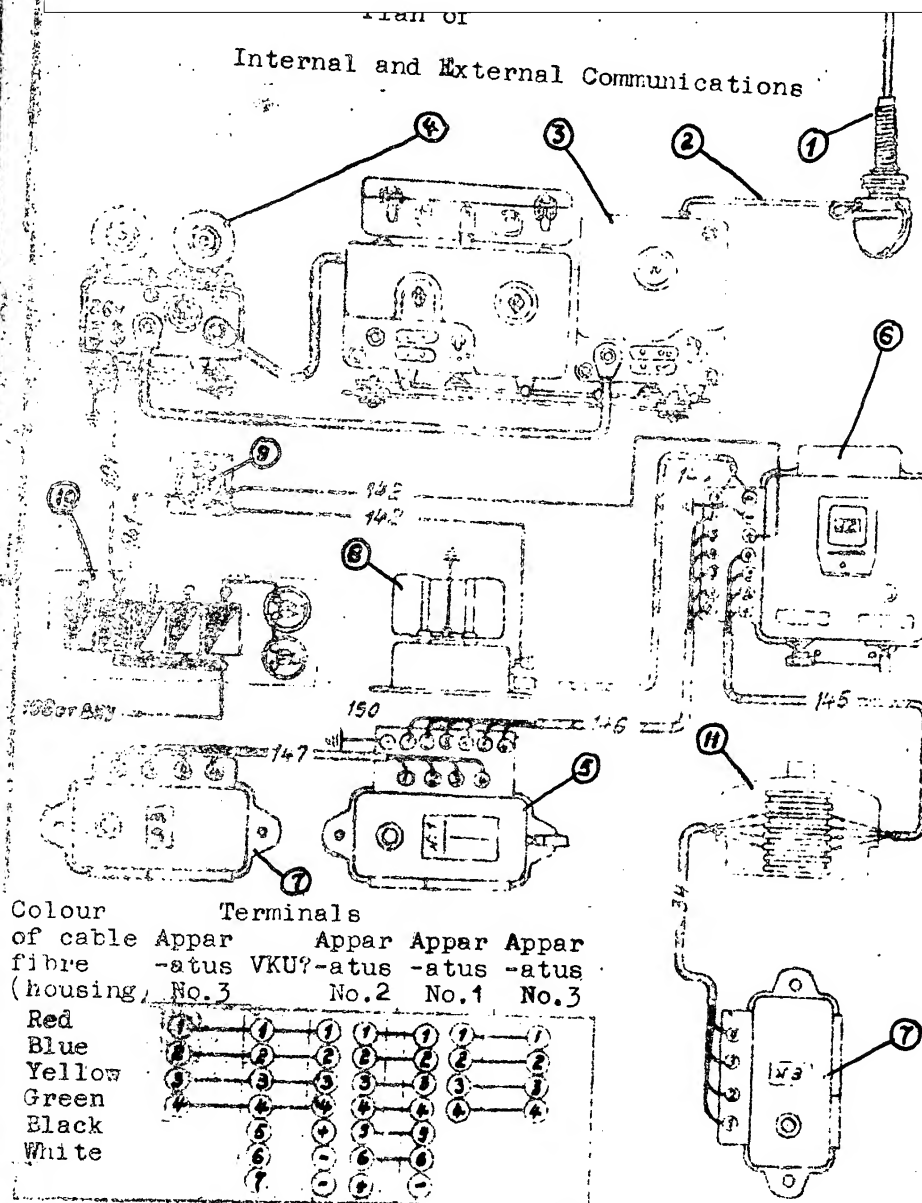
Fig. 22
08.226

50X1-HUM

SIZE B EXTENSION RING B

CAMERA FOCUSING SET TO INFINITY (∞)

Internal and External Communications



1. Aerial "ASL"
2. Aerial screening joint
3. Radio-station receiver-transmitter
4. Radio station feed block
5. Apparatus No.1 TPU
6. Apparatus No.2 TPU
7. Apparatus No.3 TPU
8. Converter TPU
9. Connecting tumbler TPU
10. Cupola electric panel
11. VKU

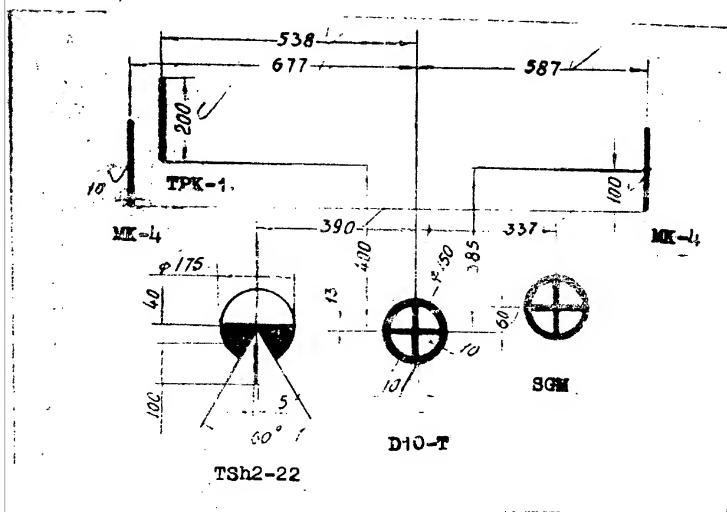
Fig 24
Sheet 119 (54.33.050-2)

50X1-HUM

SKETCH OF TESTING TARGET.

For checking the sighting lines of sight TSh2-22 and sighting instruments MK-4 and ~~TPK-1~~ with system D10-T.

50X1-HUM



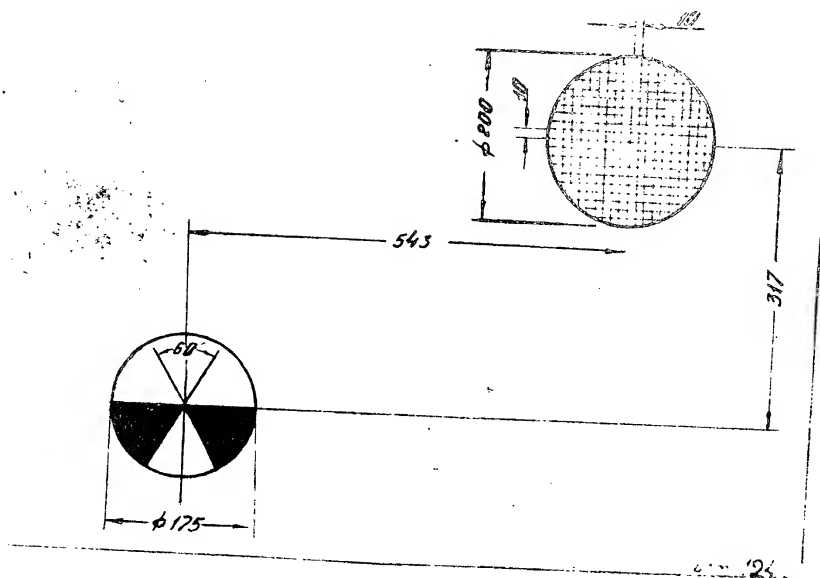
Comments.

1. The board with the testing target is to be set up perpendicularly to the axis of the barrel bore of the system at a distance of 40 metres from the muzzle mouth.
2. The cross on the muzzle mouth of the system barrel to be co-related with cross D10-T on the target. The barrel of the system must be in a horizontal position.

50X1-HUM

SKETCH OF RANGING TARGET
FOR Ranging Co-Ax Machine Gun "GCM" at a Distance of 100 meters.

50X1-HUM



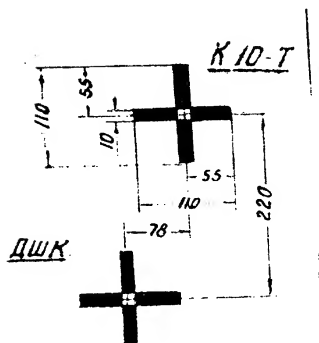
Comment.

Be guided according to
instruction 54.0? 18.

50X1-HUM

SKETCH OF A TESTING TARGET.

For Checking the Sighting Lines of Callimated
Sight K10-T from Machine Gun DShK.



Comments.

1. The testing target to be marked out in black paint on a white background.
2. The board for testing sighting lines is to be set up at a distance of 20 to 22 metres from the barrel opening (mouth?) of the machine gun.

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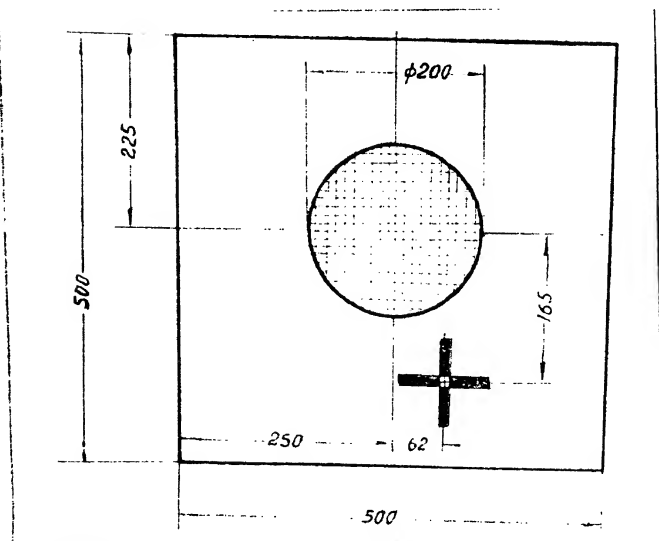
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50X1-HUM

SKETCH OF RANGING TARGET.

**For Ranging Anti-Aircraft Machine Gun DShK at
Distance of 100 metres.**

50X1-HUM



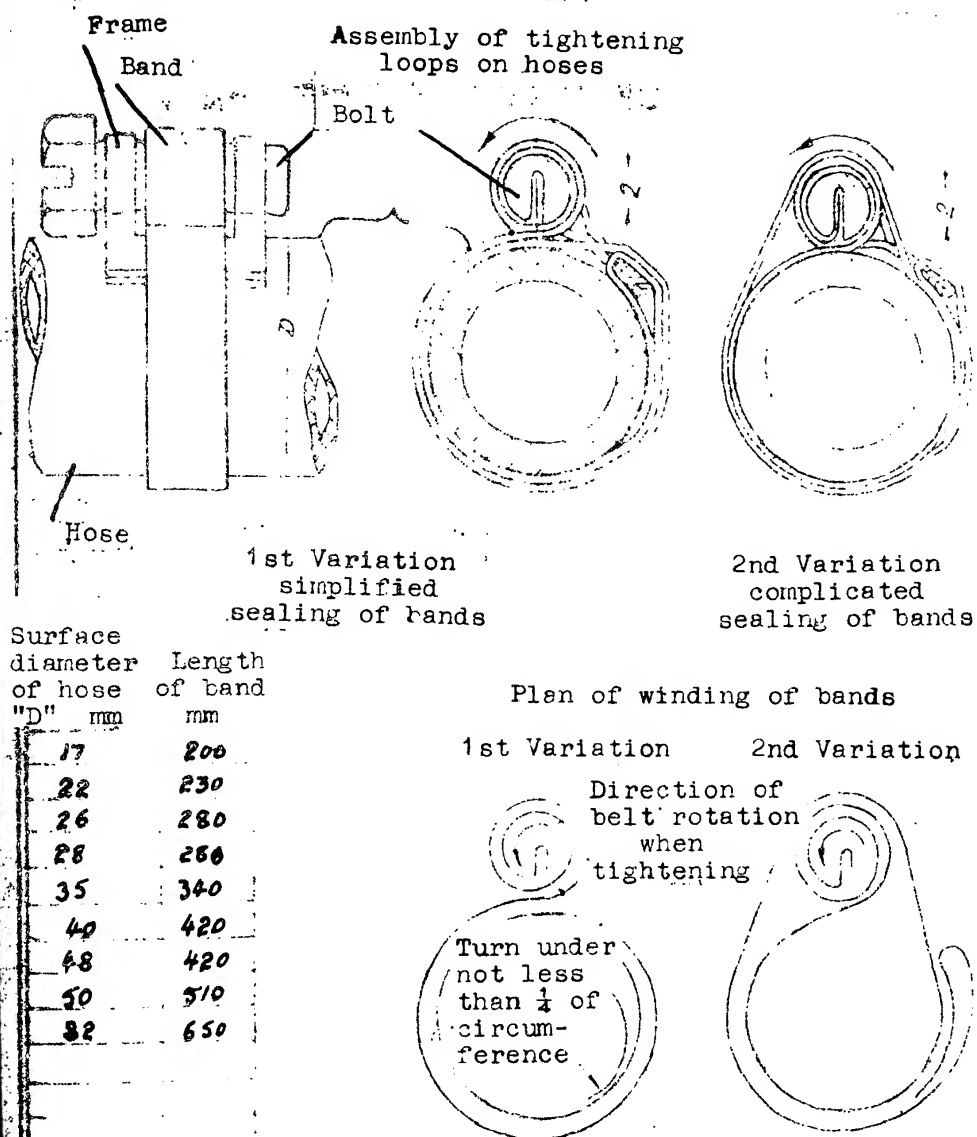
Comment.

The target is constructed with the calculation of co-relating the sighting lines through sight K10-T with the striking point at a distance of 500 metres.
(In the horizontal position of the sighting line).

50X1-HUM

50X1-HUM

SIZE B EXTENSION RING B
CAMERA FOCUSING SET TO INFINITY (∞)



Comments: 1) For a hose with a surface diameter of 48 mm. put on to cast connecting pipes of the head of the engine block, the length of the band should be 510 mm.

2) On all hoses the band around the bolt must have 2 to 2.5 rotations with a turn under of its opposite end of not less than about $\frac{1}{4}$ of the circumference of the surface diameter of the hose.

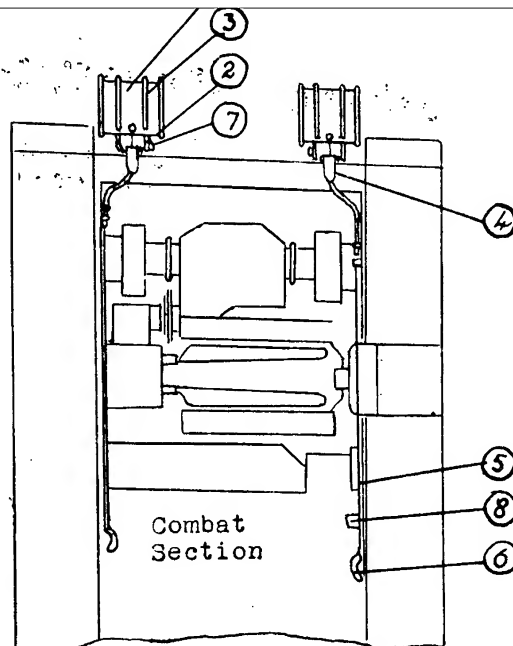
3) The loops for the surface diameter of the hoses, beginning from 35 mm are to be fitted according to the 2nd variation for sealing bands.

Fig 32
Sheet 127 (04-4)

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1. Large smoke discharger.
2. Bracket.
3. Band.
4. Lock(catch?) with covering.
5. Cable.
6. Handle.
7. Mobile box.
8. Panel with buttons.

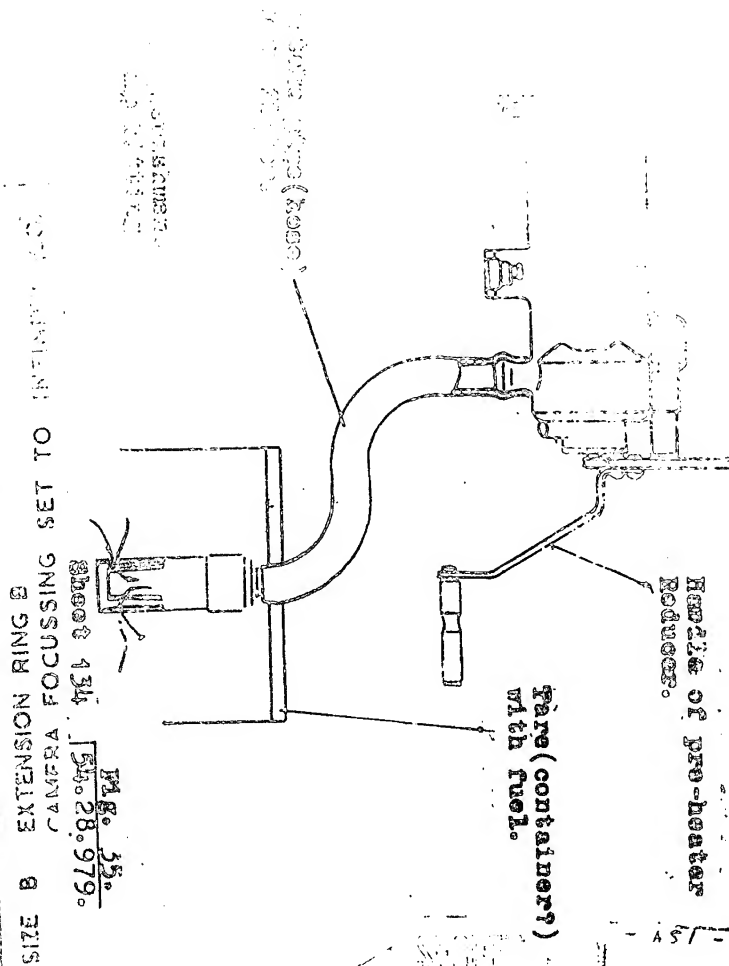
MAIN PLAN OF FITTING BD9h-5.

50X1-HUM

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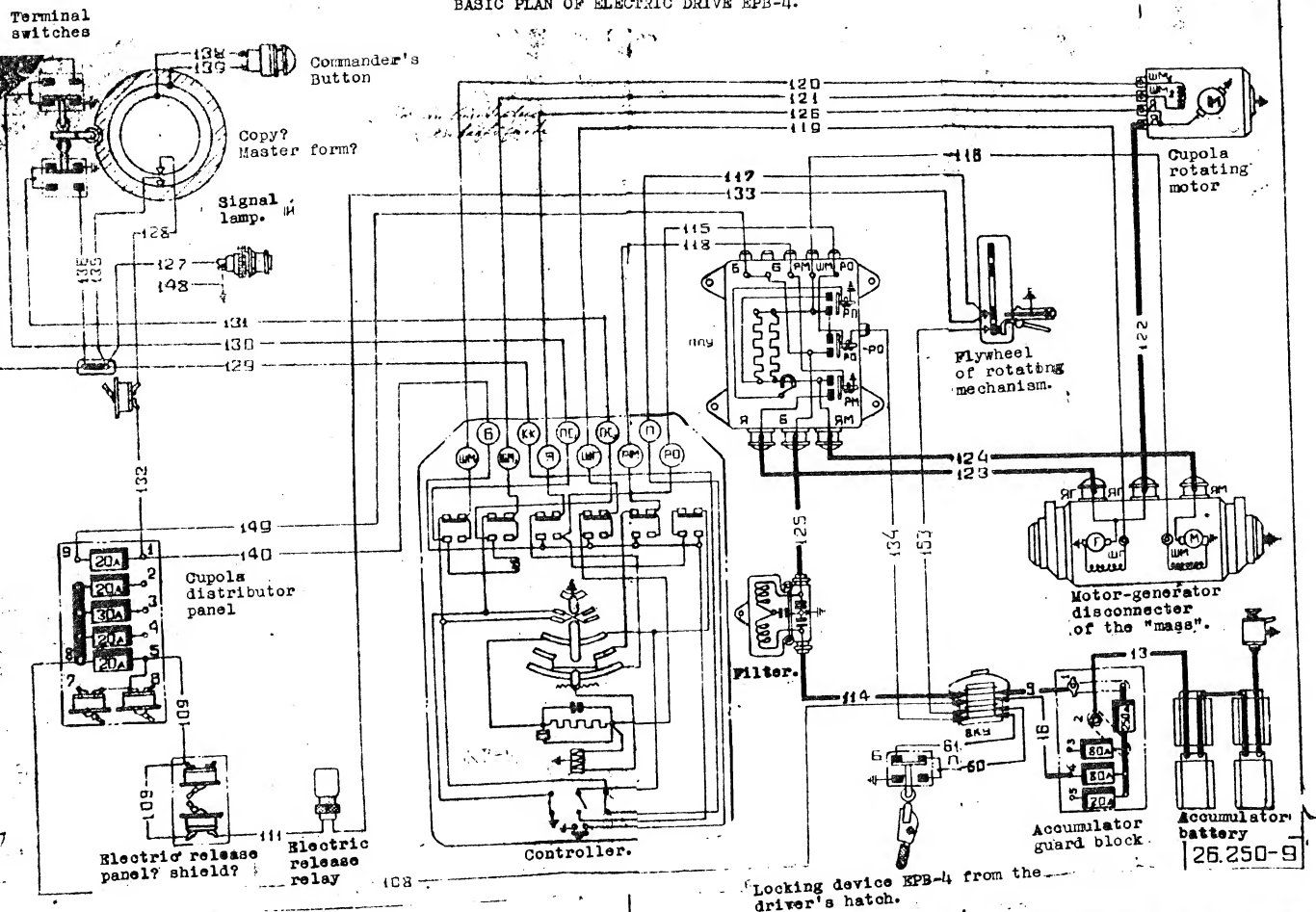
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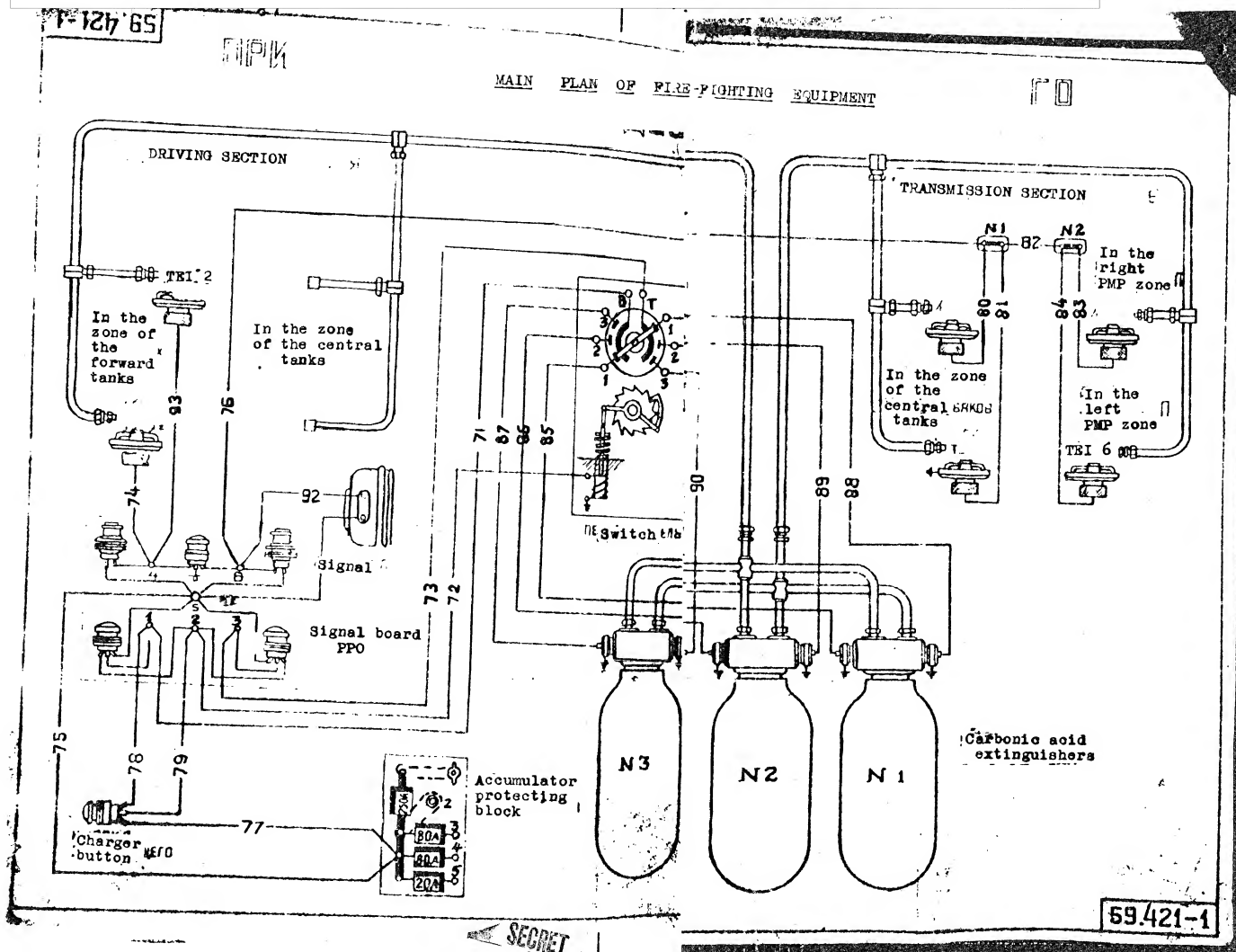
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BASIC PLAN OF ELECTRIC DRIVE EPB-4.



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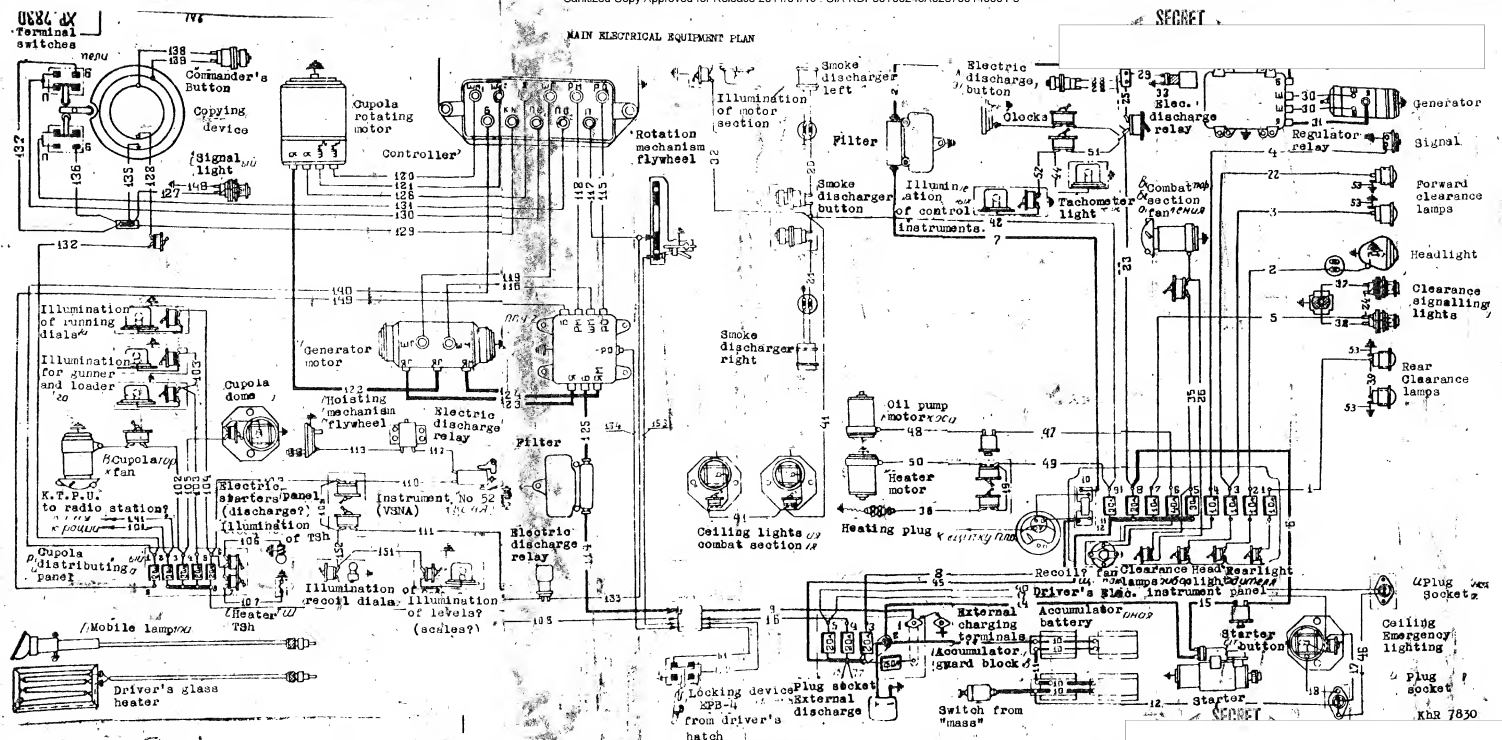
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MAIN ELECTRICAL EQUIPMENT PLAN



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SECRET

Att. No. 3



50X1-HUM

BRIEF INSTRUCTION ONOPERATING TUNES

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Page 1 Brief Instructions on Operating Tanks

Page 2

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| II | Description of the structure. | Page 101 |
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- | | | |
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S E C R E T

The present instructions regarding the operation of a tank embrace only the basic questions of service and maintenance of the engine during the process of operation.

Page 7 Certain Instructions regarding the operation of engines

I. The engine and engine components

1. The servicing of water, oil and fuel systems to be carried out according to the section "Servicing the water, oil and fuel systems" of the present instructions.
2. The oil pressure in the engine system, when working at operating revolutions must be within the bounds of 6-9 of atmospheres and with 700-800 revolutions per minute - not lower than atmospheres - all this at an oil temperature of not less than 40 deg. Centigrade.
3. During the running of the engine the engine oil temperature must not exceed 110 deg. Centigrade. If the oil exceeds this temperature it is essential to go over to a lower gear and to a lowering of the engine revolutions.
4. The temperature of the water leaving the engine must not exceed 105 deg. Centigrade. Where the contrary is the case it is essential to go over to a lower gear and a raising of the engine revolutions.
5. Before starting and also when the engine is missing during running it is essential to draw out the fuel by means of a hand pump for 5-10 seconds and to expel the air from the system by opening the air release tap situated on the cross beam of the roof of the hull.
6. After starting the engine must be warmed-up by degrees and evenly whilst idling (700-800 revolutions a minute) with a gradual stepping up to 1,200-1,160 revolutions a minute until the temperature of the outflowing oil and outflowing water reaches 30 deg. centigrade. When this temperature has been reached it is permissible to allow the motor to drive in low gears.
7. When dis-connecting external fuel tanks from the engine the external pipes must be stopped up with rubber plugs, det. 05.277 and 05.363 obtainable at the ZIP.

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8. When changing over to the spring-summer operational period the arm of the pre-heater switch tap should be turned until it can go no further so that beneath the arrow marked "P" (to be seen on the engine looking from above, see the diagrams of the heating and cooling systems) on the face of the arm the inscription "Bbikm" = (disengage) can be seen. On changing over to the autumn-summer operational period, the arm should be turned until it stops so that beneath the arrow "P" on its face the inscription "BKM" "(=engage) can be seen.

To simplify the switching of the pre-heater tap it is permissible to pull out from the body the arm of the tap together with the plug before turning.

Remember! During the summer operating period the servicing of the cooling system and its draining is to be done with the tap of the pre-heater in the engaged position. After servicing the system turn the tap arm to the position "Bbikm" "(=disengage).

To simplify the switching of the pre-heater tap it is essential firstly to raise slightly the plug of the tap by screwing on to its stem a locking nut, after which the tap can be switched.

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Having switched the tap the locking nut must be screwed up so that the free fitting of the plug in the body of the tap is ensured.

9. Fuel and oil tanks may only be washed when they are removed from the engines when the latter are being repaired.

10. When fitting bands at junction points of water, oil and fuel pipes make use of the instructions in the diagram (see fig 32).

II. Driving

1. When starting the engine it is obligatory to release the mountain (?) brake.

2. When stopping the engine on a slope it is essential to engage the mountain brake.

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3. The pedal of the main friction clutch must be pressed quickly and to the full; release smoothly and without jerking.

4. The reverse gear can be engaged only after stopping the vehicle.

5. Small obstacles can be surmounted without changing from high to low gear but with the help of the epicyclic train mechanism. For this it is essential to move the control levers of the epicyclic train to the first position. It is not permissible to travel in the slower ranges of the epicycle train for extended periods (continuously for more than 150 metres) for this leads to the overheating of epicycle train mechanism components.

III. Gear changing1. Choice of gears on moving off.

In normal road conditions move off in second gear. On particularly difficult surfaces or on steep slopes for which first gear is necessary for movement - engage first gear.

2. General principles of gear changing.

- (a) Always move in the highest gear in which movement is possible in the given road conditions.
- (b) Change gears in accordance with the lack of surface evenness in given places and the nature of the surface.
- (c) Do not allow overloading (i.e. labouring) of the engine. If the engine cuts down on revolutions and does not develop the necessary power ("does not pull"), a lower gear must immediately be engaged.
- (d) Do not change gears; when travelling over swampy land, on limited rises in deep snow, if the caterpillar tracks are buried deep in loose soil, in crossing fords, in moving over ice on rivers and reservoirs, when going over bridges and when crossing railway lines. Avoid changing on rises and slippery surfaces. In all these situations, to avoid mechanical wear, the use of the epicyclic train mechanism in its slower ranges is not recommended.

3. The method of changing from low to high gear

- (a) accelerate, smoothly increasing the fuel supply;
- (b) disengage the main friction clutch, simultaneously release the fuel supply pedal (accelerator), move the gear lever to the neutral position and engage the next higher gear:

/(c)

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- (c) swiftly, but smoothly, engage the main clutch, simultaneously increase the fuel supply.

4. Method of changing from high to low gear.

- (a) reduce the speed of movement of the tank by reducing the supply of fuel. Should a sudden reduction of speed be unavoidable the brake should be applied;
- (b) disengage the main friction clutch, simultaneously releasing the fuel supply pedal (accelerator), put the gear lever into neutral, engage the lower gear;
- (c) swiftly, but smoothly, engage the main clutch, simultaneously increasing the fuel supply.

Observation: It is recommended that the change from second to third gear should be effected with a double pressure on the clutch with intermediate pressure on the accelerator, in accordance with the general principles, since a normal spring synchroniser put into second gear does not produce a complete alignment of the engaged gears.

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IV. Electrical Equipment

1. External starter socket

Through the external contact socket of the starter motor, current is supplied for the electrical circuit of the engine from external sources of supply (from the electrical circuit of another engine or from separate accumulator-batteries) in the following situations:

- (a) When in a given machine the accumulator-batteries are absent or are flat;
- (b) when a given machine is serving as a source of supply to another machine which does not have its own source of supply.

The starting up of a starter motor by means of an external source of supply is done in the following manner:

- (a) The master switch of the given machine is turned off;
- (b) Into the scaling of the external starter socket of the given machine are placed the ends of two leads which have special tips; the other ends of these leads are plugged into the socket of the machine which is to act as the source of supply.

In inserting the leads it is necessary to pay careful attention to the polarity.

Observation: Leads for external intake are kept in the operational kit.

- (c) The master switch of the machine acting as the source of supply is turned on after which the normal starting up of the engine by means of the starter motor, proceeds;
- (d) If the external source of supply consists of separate starter accumulator-batteries, not placed in the machine, it is essential, having joined the accumulators one to another in a group with a pressure of 24 volts and having connected one end of each lead to the external intake socket, to connect the other end of each lead to the positive and negative terminals of the group. In doing this it is essential, paying attention to the polarity, to fasten the lead ends to the accumulator terminals in a firm manner.
- (e) After starting up the diesel engine by means of the starter motor disconnect the electric lead of the external intake and turn on the master switch.

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2. Driver's wind screen heater

An electric glass heater, made of wires of a high resistance alloy, is built into the driver's wind screen.

To switch on the heater it is necessary to insert a plug into the socket, the latter is to be found to the right of the driver (on the top plate of the hull).

The heater should be used only when the glass is iced over or in heavy snowfall when cleaning by hand is insufficient.

When the temperature of the surrounding air is above zero, it is forbidden to use the heater. This is to avoid the appearance of cracks in the glass.

3. External charging terminals.

External charging terminals are designed for the attachment to them of positive and negative leads of external sources of current with a pressure of 24 volts for charging the accumulators of a given machine. When charging accumulators from an external source of current the master switch of the given machine must be turned on, and the consumer's -switched off.

The external charging terminals are situated: positive - in the protective block of the accumulator, and the negative - on the guard (shield) of the electrical apparatus, in line with the protective block.

4. The method of use of the surface feed plug socket with the dual lead system

The surface feed plug socket, used in the dual lead system, ensures the operation of the inspection lamp connected to this socket, irrespective of whether the master switch is turned on or off. When working with an inspection lamp in the engine - transmission sections, to ensure security in working, the master switch must be off.

Page 13.

5. Checking the neutral position of the switch of the clearance signalling apparatus.

- (a) The position of the apparatus on a forward move must conform to the position of the switch, i.e. the lamps of the clearance signalling apparatus situated to the right and left, in front of the driver, must not be illuminated.
- (b) When the apparatus (i.e. turret and gun) is turned to the right beyond the clearance of the machine the right hand lamp should burn, when the apparatus (i.e. turret and gun) is turned to the left, beyond the clearance of the machine, the left-hand lamp should burn.
- (c) To correct the signals in the event of maladjustment it is necessary to place the apparatus in the position of "direct move forward" and turning by hand the checking device of the switch cause both lamps to be extinguished simultaneously. After this, if the apparatus is turned to the right or left, the appropriate lamp should burn.

V. Various comments1. The Cooling System

When using machines in river areas which contain a lot of mud and sand, the servicing of the cooling system must be carried out with boiled water which must be allowed to settle.

2. Accumulators

- (a) Check the level of the electrolyte not less frequently than every 6 days. When doing this, clean the ventilating apertures in the

/covers

S E C R E T

covers of the elements and carefully fasten the plugs on their covers. The level of the electrolyte above the shield plates must be within the limits of 5-8mm. If the level goes below this it is essential to pour in distilled water, after which a recharge by the motor should be effected for 10-15 minutes (the addition of water is done best of all before commencing a run of the engine).

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- (b) Every 6 days the surfaces and mastic of the accumulator batteries should be wiped over with a clean rag slightly moistened with a 10% solution of ammonium hydroxide, after which the battery should be wiped dry with a dry, clean rag.

3. Armament

1. Firing is permitted:

- (a) from co-ax machine gun - without removing the cover from the apertures in the turret beneath the machine gun;
- (b) from hull machine gun - without removing the rubber plug from the nose opening in the glacis armour plating
- (c) from main gun - without removing the cover from turret aperture for T Sh (on condition that there is sufficient visibility through the observation hole in the cover)

2. To ensure rapid firing, it is essential before firing commences to unscrew the nuts on the shell storage bins situated in the recess and on the right side of the turret, to such an extent that the screws, in case of need, can be removed without undue effort (this reduces the time needed for taking out the shells).

In conditions of heavy dust, each round must be wiped with a rag before the gun is loaded.

3. After every trip it is desirable to remove all dust from armaments, driving sections, from the turrets and their components, because during firing the light particles of dust raised by the strength of air currents settle on the working parts of armaments and the friction surfaces of mechanism and ammunition.

4. To avoid breaks in the cable of the handles of the D Sh K it is necessary to observe the following conditions:

- (a) in the travelling position of the mounting the handle must be in the proper recess of the turret with the cable coiled on the handle;

Page 15

- (b) In the combat position of the mounting the handle must be lowered into turret hatch

5. In conditions of heavy dust in the air it is essential to conduct a survey of the extent to which weapons, sighting instruments and electrical equipment have become dusty, as described in the chapter "Servicing machines after each trip", section "Electrical equipment".

Observation: The lubrication of friction surfaces directly open to dust (cogged parts, driving gears of elevating and rotating mechanism, etc), must be given only a light coating of lubricant, or (during the period of the march) the lubricant should be completely removed from the surfaces in question, since, the coating of lubricant retains the dust, absorbs it, and forms something in the nature of a mastic which gradually thickens and leads to a blockage.

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To remove such mastic it is necessary to wash with diesel fuel.

4. The driver's hatch and protective cover

1. The open cover of the driver-mechanic's hatch must be firmly fastened. To do this it must be turned to the limit; the handle of the elevating-rotating mechanism of the hatch is lowered to the position where the catch of the handle goes behind the sector recess.
2. With an adjusted forward shield of the driver-mechanic's protective cover and the emergence of a necessity to adjust also the rear portion of the protective cover it is necessary, having removed the forward shield to assemble it with the rear portion and then to put into place the assembled protective cover.

5. Cleaning and oiling turret and hatch races

The cleaning of ball bearings of turret and hatch races is carried out to obviate stiff running or jamming of the races and hatches. The cleaning should be carried out with diesel fuel or dehydrated kerosine with the help of a grease gun, until such time as the fuel or kerosine which flows out is comparatively clean. When cleaning and oiling the ball bearings of turret and hatch races it is necessary to move and rotate the latter.

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Cleaning and oiling to be carried out:

(a) Turret races

Through the bolted threaded openings; for this it is necessary to: open the 4-6 bolts situated diametrically on the upper and lower races, place beneath the lower opening a container to collect the fuel or kerosine which flows away and, inserting the diesel fuel or dehydrated kerosine through the upper opening, clean the races.

The oiling of the races is to be done after adjusting the lower bolts. The oiling is to be done with lubricant TsIATIM-201 in the quantity of 0.5 kg. After cleaning and oiling the adjusted bolts are to be splinted with wire.

(b) Hatches

Through the plugs (small diameter) for cleaning and oiling and oiling hatches.

To avoid the dripping-on of the diesel fuel or kerosine which flows away, radio apparatus and other machinery units should be covered with cloth or a container should be put into position. After cleaning, allow the cleaning liquids to run off, wipe the lower part of the hatch with a cloth until dry and service the ball bearings of the hatch with lubricant TsIATIM-201 in the quantity of 0.3kg.

The plugs which are in position must not be pierced.

Observation: Should fluid fall on to the slip-rings the latter must be wiped dry. Electric switches are to be protected from the falling liquid by being covered with cloth.

(c) Hatch bolts

Hatch bolts are to be cleaned if the bolt handles are stiff to manipulate.

The cleaning is to be done in the following way:

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1. Dismantle the bolt by unscrewing the upper stop screw and then remove the bolt by its handle.

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2. Clean the components in dehydrated kerosine or diesel fuel and wipe dry with a rag. The bolt seat to be cleaned with a cloth damped with dehydrated kerosine or diesel fuel and wipe dry.
3. Assemble the hatch bolt, carefully oiling the parts and bolt seating with a thin film of lubricant.
4. After assembling the bolt the upper recess is to be filled, through the oval aperture on top, with lubricant UCo-2 to a quantity of 0.01 kg.

Tarpaulin Coverings

Tarpaulin covering (item 28.282 cb) before being stowed must be folded along its larger side ($\phi = 10m$) in 8 panels) of a width of 1250mm each and then firmly rolled and fastened by two straps (28.42 cb.1).

VI. Rules for preparing anti-aircraft equipment
D Sh K for action

The preparation of an anti-aircraft equipment for action must be carried out in the following order:

1. Remove the cover from the equipment.
2. Transfer the equipment from the "march-combat" position to the "combat" position.
3. Check the fixing of the mounting on the turret. If necessary, tighten up the clamping screws with the help of the cocking handle (on the reverse side). The degree of tightness must be such that the mounting rotates tightly around the axis of the bracket shank when full manual effort is exerted in the aiming position 400-600mm.
4. Stop the mounting in the action position with the help of the stop (catch?), located on the turret. In doing this the conical portion of the stop catch must go as far as possible into the conical recess on the lug of the shank.
5. Check the fixing of the machine gun and if necessary tighten the fastening nuts to the slide block (?).
6. Adjust the magazine, open the cover and adjust the (ammunition) belt in the feed block of the machine gun.

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7. Unlatch the cradle (the latch is situated on the left of the shank).
8. Open the lid of the box of the collimator sight K-10-T.
9. Cock the breech block with the help of the cocking handle (?).
10. Unlatch the turret.

Observation: To improve the accuracy of fire it is recommended, after laying for elevation, that the cradle be locked by releasing the keys of the elevating mechanism.

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VII. Rules for the T. & A. of the anti-aircraft
"D Sh K" for normal combat

The preparation of anti-aircraft equipment "D Sh K" for normal combat takes place in the following order:

1. Carry out the preparation of anti-aircraft equipment as for action (see the section in the present instruction on rules for preparing).
2. At a distance of 100 metres from the muzzle face place a white shield not smaller than 0.5 X 0.5 metres with signs inscribed on it as in fig 31.
3. Place the sight leaf in the action position and position the sight slide on scale graduation 1. The rear sight must be positioned at zero.
4. Turning the turret and elevating mechanism, take aim through the leaf sight at the centre of the circle on the shield, after which, without disturbing the aim, brake the turret by letting down the cradle and turret catches and releasing the keys on the handle of the elevating mechanism.

In place of a leaf sight it is possible to sight a machine gun on the centre of the circle with the aid of tubes for cold adjustment (T Kh P).

5. Looking through the collimator sight and using the regulating screws for adjustment superimpose the crossed lines of the sight on the crossed lines on the shield.

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6. Unlatch the equipment and, superimposing the cross in the sight on the cross on the shield, fire 2-3 shots and correct the aim after each shot. The bullets must be within the circle.
7. If the bullets have not fallen within the circle then it is necessary: either to repeat the adjustments described paras 4 and 5 or, having measured the margin of error between the centre of the group and the centre of the circle and making use of the graduations on the regulating bolts, alter the point of alignment (through the sight K-10-T) in that direction and to that extent to which the centre point of the group had been off target.

Example. The centre of the group was off target by 20 cm above and 15 cm to the right. In this case it is necessary:

- (a) In order to lower the point of strike by 20 cm - shift the upper regulating screw by one graduation.
- (b) In order to alter the point of strike by moving 15cm to the left - shift the lower regulating screw by $\frac{3}{4}$ of a graduation (turning the regulating screw by one graduation results in a change in the point of strike of two-thousandths of the range, which in the case of 100 metres equals 20 cm).

Observations: I. At the very beginning of the adjustment process it is essential slightly to loosen the clamping bolts of the brackets of the "K-10-T" sight housings. After adjustments have been completed they should again be tightened.

II. If in the process of adjustment it is necessary to screw up any of the regulating screws, then it is necessary first of all to unscrew the screw, which corresponds to it and is found in directly opposite, to an extent not greater than is required to screw up the regulating screw with graduations. If the regulating screws need to be unscrewed the screws mentioned must be screwed up to make a tight barrier.

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8. After completing the adjustments it is essential to check the action of the machine gun. To do this 8 single shots are fired at the shield and the aim is corrected after each shot.

A machine gun is regarded as adjusted for fire if not less than six shots are in the circle.

After putting the machine gun into normal combat order all screws of the adjusting mechanism must be locked with wires.

VII. Rules for the T & A of the co-ax for normal combat

The T. & A. of the co-ax for normal combat must be carried out in the following order:

1. At a distance of 100 metres from the muzzle of the machine gun place a white shield measuring 1x1 metre with the signs inscribed as in fig. 29.

2. Put the sight (at?) 4 on the machine gun sight graduation and, working the elevating and traversing mechanism, take aim by superimposing the central square of scale T Sh with the square on the target, after which, without shifting the alignment, fire 4 single shots.

3. If 4 shots or the 3 best of the shots, with the other clearly astray, are contained in a group of 15 cm and the centre of the group is not more than 3 cm from the centre of the circle on the shield, then the machine gun is considered T & A'd.

If the centre of the group is farther from the centre of the circle than the distance mentioned it is then necessary to measure the extent of the error and, with the aid of the graduations on the nuts of the aligning mechanism, make the necessary adjustment.

For Example: The centre of the group was off target by 30cm above and 15cm to the right.

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In this case it is necessary:

1. To transfer the point of impact 30cm downwards unscrew the lower nut of the vertical screw of the aligning mechanism for 3 large graduations and also screw up the upper nut for 3 large graduations.

2. To transfer the point of impact 15cm to the left - unscrew the left nut of the horizontal screw of the aligning mechanism for 1½ large graduations and also screw up the right nut for 1½ large graduations. (Turning the nut for 1 large graduation is equivalent to transferring the point of impact for one thousandth of the range, which for a distance of 100 metres is equal to 10cm). After making the indicated adjustment it is essential to repeat the checks described for machine gun action with four single shots.

After checking the machine gun action by single shots the action of the mounting (installation?) must be checked with automatic fire.

For this, after sighting on the target a burst of ten rounds is fired.

The action of the machine gun is considered normal if not less than 8 shots out of 10 strike the target in a group with a 20cm diameter and the centre of the group is not more than 6 cm from the centre of the circle on the shield.

After T & A the co-ax for normal combat, the nuts of the aligning mechanism must be locked with wires.

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Page 22Tank MaintenanceI. Control Inspection

Takes place before each run of the tank and during short halts on the march for the purpose of checking on the tank's readiness for movement.

Para No.	Designation of joint, mechanism, assembly	Action to be taken	Observations
(a)	(b)	(c)	(d)
1	Cooling system	Before run, check on the presence of water or anti-freeze.	For a fully serviced system the level of water in the pouring neck must reach the beginning of the threads.
2	Oil system.	Check on the presence of oil in the oil container.	If there is less than 20 litres in the container the machine may not be started on a trip. Before re-filling the oil system it is necessary to turn over the engine for 2-3 minutes at 800-1000 revs per min.
3	Fuel system	Check whether the air bleeder tap is fully turned off.	
4	Fuel lubricating and cooling systems	Check the connecting and bore joints, correct any irregularities found.	
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5	Electrical equipment	Check the charging of the accumulators and effectiveness of the external and internal lighting	If the voltage pressure falls below 17 volts when the engine is started up, then it is necessary to charge the accumulators.
6	Sighting instruments	Wipe dust from the glass.	
7	Tracks	Check the tension and, if necessary, tighten. The displacement of the crank and bracket cogs is caused by the anti-clockwise rotation of the right hand leading worm and clockwise rotation of the left hand leading worm. The tightening of the tracks is carried out by the rotation of the rear worms in a clockwise direction.	With normal track tension the upper track must lie on the three central bogies without sagging and without touching the forward and rear bogies. The track tension should be tested on a level stretch of ground with a firm surface.
8	Driving Controls	Check on the action of the handles and pedals of the driving mechanism and assemblies.	

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	(b)	(c)	(d)
9	Radio set IORT-263	Check the working	
10	TPU-47	Check the working	

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D. At Stops during the move

(a)	(b)	(c)	(d)
1	Engine- transmission section	Check the condition of pipes, hoses and connections. Repair any leaks and defects found.	With the water radiator raised.
2	Gears, driving wheels, idlers bogies and hydraulic shock absorbers.	Check the heat by feel. Look over the places at which oil might flow out.	
3	Equipment and attachments (external)	Check the reliability of fastenings.	

II. Technical Servicing No. 1

Technical Servicing No. 1 takes place after every trip made by a tank irrespective of the mileage (motor hours) with the object of conducting a check and preparing for further operations. Faults found to be corrected.

Para No.	Designation of joint, mechanism, assembly	Action to be taken	Observations
(a)	(b)	(c)	(d)
1	Systems: fuel, oil and cooling	Examine pipe and hose connections. Correct any faults found. Replenish fuel, oil and water in accordance with the section "Filling the water, oil and fuel systems" of the present instruction.	
2	Equipment and attachments (external)	Check on presence, condition and fastening.	
3	Armaments, Covers.	Check the reliability of the catches on turrets, guns and anti- aircraft machine guns. Check the cleanliness of machine gun surfaces, ammunition belts. If necessary, rub over. In firing with a hull machine gun it is essential to remove the belt from the deflector bag after 250 shots and the deflector-bag should be cleared of cartridges after 500 shots. The cartridge belt receiving bag of a twin machine gun should be cleaned after 500 shots. Check the presence of covers. Covers must be kept on and only when unavoidable should they be taken off and laid in any vacant spot: in the recess of the turret behind the shell store, in a box on the flaps, etc.	

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(a)	(b)	(c)	(d)
		<p>Covers to be put on the following units and joints:</p> <ol style="list-style-type: none"> 1. On the face of the turret. 2. On the right and left turret embrasures. 3. On hull and co-ax machine guns "SGM". 4. On machine guns "D Sh K". 5. On the catches of turrets and shafts of machine guns "D Sh K". 6. On the breech and muzzle faces of D10-T systems. 7. On the ventilators of firing and engine sections. 8. On the turning mechanism of the cupola. 	<p>The covering of general (?) "SGM" is done in accordance with fig. 37.</p> <p>The covering of paired "SGM" is done in accordance with fig. 38</p>
4	<p>Running gear</p> <p>(a) idlers, suspension wheels, balancing pivots, hydraulic shock absorbers, driving wheels and side transmissions</p> <p>(b) Caterpillar tracks</p>	<p>Check the tightness of bolts of all the mechanical items mentioned and the tightness of plugs strengthening the drive wheels on the driven shafts.</p> <p>Check the tension and, if necessary, tighten-up. The displacement of the crank and bracket cogs is caused by the anti-clockwise rotation of the right hand leading thread and clockwise rotation of the left hand leading thread. The tightening of the tracks is carried out by the rotation of the rear threads in a clockwise direction.</p>	<p>The inspection to be carried out by external checks - tapping with small hammers, as far as access permits without dismantling the mechanism.</p>
5	Fuel Tanks	Clean the holes in the plugs which are for the free passage of air into the tank (in the central and forward ones).	
6	Transmission section	<p>Inspect the assemblies, making use of an inspection lamp. Correct any faults found.</p> <p>If leaks are found in any of the parts, check the oil level and, if necessary, replenish.</p>	<p>Pay attention to locking wires and the firmness of bolts.</p>

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(a)	(b)	(c)	(d)
7	Driver's sighting instruments	Remove the driver's sighting instruments from their shafts and, if necessary, clean them and the shaft recesses, removing dirt and dust. After cleaning the shaft and crimp of rubber packing of the sighting instruments oil them with lubricant TsIATIM-201	

Electrical equipment

8	The driver's electrical instrument board.	Before stopping the engine check that the generator is charging by the volt/ampere meter.	
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9	Signalling board PPO by the driver	Check the effectiveness of the signalling lamps and signal PPO.	
10	PPO buttons on the driver's signalling board and on that of the commander.	Check the presence of cellophane protectors.	
11	Body and Turret ventilators	Check by switching on.	
12	Fuse plugs (protectors)	Check on the reliability of the strength of fuse plugs and do not allow them to be changed for extraneous objects.	
13	Apparatus for internal lighting and lamps	Check by switching on.	
14	External Signal	Clean off dirt but do not wash with water sprayed under pressure; check working by switching on.	
15	Electric triggers guns and machine guns.	Check the working order of electric triggers in order to confirm that guns and machine guns are not loaded. Cock the striker of guns and the moving parts of machine guns. Press the appropriate buttons of the electric triggers and release.	
16	Accumulator shelving	Check the fastening of the accumulators and, if necessary, tighten the bolts.	
17	Commander's hatch contacting circuits, brushes contacting circuits of rotating mechanism	Clean away dust and dirt	50X1-HUM

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(a)	(b)	(c)	(d)
18	Turret rotation electric leads	Check the working of the electric leads from the control and the commander's controlling buttons by switching on for short periods of 1-2 seconds.	If the front and rear clearance warning lamps are hermetically sealed in construction, clean only the exteriors.
19	Fire-fighting cylinders and the PPO meter	Ensure the presence of seals on the tops of the cylinders of the signalling panels and meter-switch.	
20	Clearance warning lamps front and rear.	Clean dirt and dust off the exterior and interior of the lamp bodies to ensure cushioning, and wipe glass.	
21	Headlights	Check the working of lamps by switching on. Clean dirt from exterior and wipe glass without removing. After cleaning check lamps are working by switching on.	
22	All electrical energy consumers, instruments, lights and master switch.	On leaving the machine, ensure that switches are off.	

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In hot and dusty conditions the following must additionally be done

(a)	(b)	(c)	(d)
1	Cooling system	Unscrew the exhaust valve, clean away dust and wash with water.	
2	Fuel system	Wash the plugs of fuel tanks and flotation apparatus.	
3	Electrical equipment.	Open the covers of protective shields and clean dust from panels, terminals and plugs.	
4	Commander's hatch contact installations and rotating mechanism.	Wipe with a clean cloth the contact circuit on the hatch race and the brushes of contact installations and rotating mechanism.	
5	Commander's hatch.	Check ease of opening and closing. If necessary, clean and oil the shutting mechanism with lubricant UCo-2	

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(a)	(b)	(c)	(d)
6	Exit louvres	Check the ease of opening and closing. Should there be jamming in hinges it is essential to correct this and then oil with lubricant UCc-2.	
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7	Gun Installations	<p>(a) Check the ease of rotation of hand wheels of elevating and traversing equipment should the hand wheels of elevating equipment be tight in rotation, clean the drive gear cogs of the elevating mechanism and section of the gun.</p> <p>Should the hand wheels of traversing equipment of the turret be tight in rotation, clean the drive gear cogs of the traversing mechanism and lower race cogs.</p> <p>The cleaned surfaces to be oiled with a thin coating of gun grease.</p> <p>(b) After the completion of a march with uncovered gun barrels, check the conditions of the chamber and barrel bore.</p> <p>If necessary, carry out cleaning and oiling in accordance with the directions according to the system D 10 T</p>	
8	Anti-aircraft gear D Sh K	<p>Check the ease of rotation of the hand wheels of vertical operation.</p> <p>If rotation is still, clean the drive gear cogs and the section on the cradle by means of a cloth damped with diesel fuel; or wash with diesel fuel, after which, coat with a thin film of gun grease GOST 3005-51</p>	
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9	Machine-gun equipment	Check the condition of moving parts and cartridge chambers. If necessary, clean and oil.	
10	Driving controls FMP and KPP	If there is a great increase in the power (to be used?) on FMP levers and the crank lever it is essential to wash out with diesel fuel the hinge joints and needle-bearings of the driving controls.	
11	Sighting Instruments	Remove and wipe over the blocks with prisms from the driver's sighting instruments and commander's hatch. Clean the shoes and replace the blocks.	

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III. Technical Servicing No. 2

Technical servicing takes place after every 1,000 kilometres of running with the object of checking the technical condition of the tank and bringing it to full readiness for further use.

Para No.	Designation of joint, mechanism, assembly	Action to be taken	Comments
(a)	(b)	(c)	(d)
		Carry out all tasks described in Technical Servicing No. 1 and, in addition:	
		Engine Installation	
1	Fuel, oil and cooling systems	Inspect the condition of pipes, pipe and hose connections. Repair leaks and defects found. Ensure that fuel and water is in proper supply. Change oil. Replenishment to be conducted in accordance with section: "Supply of water, oil and fuel systems" in the present instructions.	Before replenishing the forward and middle tanks allow 5-10 litres of fuel to run out through the drainage taps, having first allowed the fuel to settle.
2	Oil filter	Wash out	
3	Air cleaner	Service the air cleaner in accordance with the section: "Maintenance of air cleaners" - in the present instructions.	In winter, when there is a mantle of snow the air cleaner is not to be serviced.
4	Fan Drive and fan clutch	Inspect condition and check fastening Replenish bearings with oil. Check the fastening of the cogged couplings on hubs.	Inspect the condition of the fan. Check the tightness of bolts and their locking to the ventilator, cogged couplings, drive casing and axis. Correct any defects found. Replenish with oil the fan drive bearings.
5	Exhaust system	Inspect the condition of connecting pipe fastenings and packing of joints and also the condition of manifolds and connecting pipes. Correct any defects and looseness found.	
6	Fuel filters for fine and coarse filtration. Vertical pipe for draining fuel	Wash out Clean away dust and dirt from the sieve and opening of the pipe.	In winter, when there is a mantle of snow the fine filter is not to be cleaned while the coarse filter is to be washed after the engine has operated 50 hrs.
7	Fuel Pump	Check fastening of fuel pump and high pressure pipe.	
8	Control Instruments	Check accuracy.	

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		(b)	(d)
		Transmission and Driving Gear	
1	Gear Box	Inspect the condition of cogged couplings, joining the gear box to PMP, and their catches, the junction of the speedometer flexible shaft. Correct any defects found. Check the oil level and replenish to a level of 59-62mm. This level is equivalent to the upper notch of the rod 28.205-2 by the letter "K" and a general content of oil in the KTF of 12.5 to 13.5 litres or 11-12 kgr.	The lowest permissible level of oil at which the operation of the mechanism is allowed is 55mm, which corresponds to the lowest notch on the rod 28.205-2 by the letter "K".
2	Gear Box Vertical Driving Shaft	Oil.	
3	Disconnecting devices of main clutch and locking clutches of PMP	Replenish with oil.	See Section: "Periodic lubrication of mechanism"
4	Swinging Arms (?)	Check the fastening of swinging arms, the condition of coupling muffs and their locking. Correct any faults found. Check the oil level and replenish to a level of 148-152mm. The level mentioned corresponds to the upper notch on the rod 28.205-2 by the letter "T" (=G or H) and a general content of oil in the swinging arms(?) of 6-7 litres or 5.5 to 6.5 kgr.	The lowest permissible oil level at which the operation of the mechanism is permitted is 142mm, which corresponds to the lowest notch on the rod 28.205-2 by the letter "T" (=G or H)
5.	The stopping and small brakes of PMP.	Check the condition of bands and hinge joints regulating the bands, minor brakes according to arrows (indicators?) and also the tension of the bands of stopping brakes. Oil hinges (joints?).	See Section: "Periodicity of mechanism lubrication".
6	Driving gear of fan KPP and clutch couplings	Check the firmness of clutch couplings, replenish oil in bearings	Ditto
7	Epicyclic gear	If necessary, replenish oil	See Section: "Periodicity of mechanism lubrication". Check the oil level through the control apertures. Replenish immediately after running, while the oil is still hot.

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(a)	(b)	(c)	(d)
8	Cranks	Check the working of the crank bolts, correct any faults found. Check the fixing of the cables and insulated wires. Oil rubbing surfaces.	See Section: "Periodicity of mechanism lubrication".
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9	Driving gear	Check: adjustment of driving gear, condition of hinge joints of journal bearings, tightness of nuts, bolts and the splinting of hinge pins. Correct faults and oil rubbing surfaces.	See Section "Regulating of driving gear" and "Periodicity of mechanism lubrication"
		Running gear	
1	Idlers, suspension wheels, balancing pivots, hydraulic shock absorbers, driving wheels and side transmissions.	Check the tightness of bolts of all mechanical items mentioned and the firmness of plugs strengthening the drive wheels on driven shafts.	The inspection to be carried out by external checks - tapping with small hammers, as far as access permits without dismantling the mechanism.
2	Buffer fittings	Check the condition and firmness. Correct any defects found.	Surface inspection without dismantling.
3	Caterpillar tracks	Inspect. Change any defective tracks sections or pins discovered, ensure that track tension is regulated to normal. The displacement of the crank and bracket cogs is caused by the anti-clockwise rotation of the right hand leading thread and clockwise rotation of the left hand leading thread. The tightening of the tracks is carried out by the rotation of the rear threads in a clockwise direction.	To achieve normal tension of tracks it is permissible to remove track sections from the track band. In doing this the number of track sections remaining on the left and right bands must be the same.
		Electro Radio Equipment	
1	Accumulators	Check the condition of external terminals and the firmness of correctors.	
2	Starter	Check the fixture of the starter motor and leads to it.	
3	Turret electrical lead assemblies.	Check the fixtures and working order.	
4	Radio equipment	Check fixtures.	
5	Lamps and fuses	Check working order.	

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(a)	(b)	(c)	(d)
Turret			
1	Turret Traversing Mechanism	Check the firmness and if necessary tighten bolts. Check the traverse of the turret by hand and by electric drive. If the turret is stiff in traversing unscrew the 4-6 diametrically positioned bolts, fixing the upper race, and through the aperture wash the race with dehydrated kerosine or diesel fuel and replenish with fresh oil.	See Section "Periodicity of mechanism lubrication".
<u>Page 39</u>			
2	Races of turrets and guards (?)	Check the firmness of the upper and lower races and, if necessary, tighten the bolts.	
3	Turret seat	Check the firmness and, if necessary, tighten the bolts.	
4	Turret catch	Check the firmness and, if necessary, tighten the bolts.	
5	Commander's cupola and loader's cupola.	Check the working order and ease of rotation of the hatches on the ball bearings and the covers on the hinges. If rotation is stiff, wash with dehydrated kerosine and oil.	Ditto
6	Mounting and mechanism of the anti-aircraft D. Sh K.	Check on the working order of mountings and ease of rotation of turrets and the handwheel of the D Sh K carriage. If rotation is stiff, wash with dehydrated kerosine and oil.	Ditto
Armament			
1	Armament and auxiliary fittings	Check the working order of assemblies and their fixing. If necessary tighten the fixing bolts. If prolonged firing has taken place, oil pivots, cradle section, cog wheels, machine gun slides and cocking rollers (?). The cradle section and cog wheels of the elevating mechanism to be washed first then wiped dry with a cloth.	See Section: "Periodicity of mechanism lubrication"
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Equipment and Fittings			
1	ZIP Packing on machine exterior.	Check on presence and fixing.	
2	ZIP Packing inside machine	Check on presence and fixing.	

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(a)	(b)	(c)	(d)
3	Sighting instruments	<p>Check working order, clean dirt from shafts. Oil packing glands and wipe glass. Foundation shafts of the driver's sighting instruments to be wiped and oiled-in winter with lubricant No. 21 GOST 3258-46 - in summer, with gun grease GOST 3005-51.</p> <p>Should there be a loss of visibility through the protective glass of TPK-1 (moisture, ice, presence of dust, etc) it is essential to clean the protective glass, for this:</p> <ol style="list-style-type: none"> 1. Open instrument TPK-1 2. Take out the upper prism of the instrument. 3. With a glass wiper (flannel or cloth) wipe the internal surface of the glass. 4. Re-assemble the instrument. <p style="text-align: center;">Body</p>	
1	Removable part of roof	Check the tightness of bolts fastening the roof.	
2	Driver's hatch	Check the working order of the hatch and if necessary clean and oil.	See Section "Periodicity of mechanism lubrication"
3	Escape hatch	Check the firmness of hatch catches (bolts?).	Fasten bolts with hammer blows.
4	Towing hook catches	Clean away dirt, check working order, if necessary correct defects and oil	See Section: "Periodicity of mechanism lubrication".
5	Shutter gear	Oil rubbing surfaces of the gear and axis of shutters	Ditto

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In hot and dusty conditions, additionally do the following:

Para No.	Designation of joint, mechanism, assembly	Action to be taken	Observations
(a)	(b)	(c)	(d)
1	System setting (?)	<p>If there is stiffness in the rotation of the hand wheels of the elevating mechanism after cleaning or washing the driving pinions and the cogs of the section on the cradle with diesel oil, it is necessary to wash with diesel oil the pivot systems (not having gland packings), through the plug with a spray (grease gun?). After this replenish the pivots with gun grease GOST 3005-51.</p>	

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(a)	(b)	(c)	(d)
2	Anti-aircraft mounting D Sh K	On mountings not having protective hoods on the turret catches (hatch races) and shanks, it is essential to clean these catches and wash them in diesel fuel followed by lubrication with a light film of gun grease GOST 3005-51.	
3	Roller bearings of the commander's turret and loader's turret	If there is stiffness in rotation wash through.	
4	Terminal switch panel for commander's instruments.	Clean dust from the body of the stock, the return spring of the body of the stock, the stocks (rods?) of terminal switches and rollers after which lubricate with a thin film of gun grease GOST 3005-51.	

IV. Technical Servicing No. 3

Technical Servicing No. 3 is carried out after every 2,000 kms of running with the object of checking the technical condition of the tank and putting it into a state of complete readiness for further use.

Para No.	Designation of joint, mechanism assembly	Action to be taken	Observations
(a)	(b)	(c)	(d)
		Carry out all tasks described in Technical Servicing <u>No. 2</u> and, in addition:	
		Engine Assembly	
1	Oil system	Change oil	Run the oil out fully, whilst hot, through the outlet valve of the oil tank and also through the outlet plug of the oil tank (sump) settler.
2	Oil filter "KIMAF-ST 3 and coarse filter of the oil tank	Wash out	"Oil filter KIMAF-ST 3" to be washed out according to the special instructions accompanying the engine. To ensure the removal of oil filter section "KIMAF-ST3 it is essential to: (a) disconnect from KPP the cables (rods?) "P-Sh" and "TV-V" (or IU-U") of the transmission.
Page 44			50X1-HUM / (b)

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(a)	(b)	(c)	(d)
			(b) Remove fastening clamps of speedometer cable and capillary from KPP having freed the cable.
			(c) It is also advisable to remove the fastening clamps of the water pipe from the KPP. After replacing the filter section it is essential to restore all previously removed clamps".
3.	Fuel system	To remove sediments, pour off 5-7 litres of fuel from each group of fuel tanks, having previously allowed the fuel to settle.	
4	Fuel pump	Change the oil in the fuel pump regulator. Replenish to the level of the control plug.	

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5	Speedometer and tachometer cables	Put 20.30 gr. of oil MT-16P into each cable cover.	
		Transmission and Driving Gear	
1	Gear change Box	Carry out oil change during intermediate servicing (repair) of tank or during the dismantling of K.P.	Run off oil whilst hot. Fresh oil to be poured into a level of 59-62mm.
		Check the tightness of nuts, tie bolts, firmness of yokes and forward lugs.	If they have loosened, tighten up.
2	Transmission Mechanism clutch couplings	Wash cogs out in graphite grease of the following composition: 35% graphite P-Ost 10555-40 or graphite GOST 4596 49 and 65% oil UCo-2	The washing of clutch couplings to be done only if the appropriate assemblies are being dismantled and during intermediate repair.
3	Epicyclic gear mechanism	Check the oil lever and, if necessary, replenish.	Check the oil level through the inspection openings. Change the oil during intermediate repair or when the PMP is being dismantled.

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4	Fan clutch	Check the point (moment?) of slipping of the fan clutch. If as the result of appreciable wear of the FERRODO lining the point of slipping is less than that permitted, the friction driving plate should be changed. In a case where the point (moment) of slipping is greater than that permitted. The clutch should be dismantled and if the friction discs are in a satisfactory condition, rub the /friction	The clutch must slip with the rotation of the ventilator at a moment of 18 to 50 kgm. If being moved from position (mobile?) the moment may be increased by 5 kmg.
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(a)	(b)	(c)	(d)
4 (contd)		friction surfaces with dry tool and re-assemble the clutch.	50X1-HUM
5	Swinging arms (?)	Effect oil change during intermediate repair of tank or when dismantling swinging arms.	Drain oil whilst hot. Fresh oil to reach a level of 148-152mm.
6	Cranks	Check the condition of crank mechanism and replenish with oil.	At very low temperature (from 30°(SIC) and lower) the crank mechanism to be washed and assembled without oiling. Oil rubbing surfaces with a waste rag oiled with the oil used in the machine.

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7	Side Transmissions	Replenish with oil TsIATIN-208 at the rate of 500 grammes for each side transmission, change lubricant after 4,000 km.
		Running gear
1	Bogies, idlers	1. Check by external inspection. If abnormalities are found, dismantle and if necessary change defective parts. In taking down joints remove the old oil and wash all components in gas oil. Release of pressure on pressure rings in packings to be effected only when it is essential to change rubber cuffs. After assembling, replenish oil.
2		Replenish oil

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2	Rocker bearings, rocker and bumper fittings	Check by external inspection. Correct any defects observed. Replenish with oil the internal recesses of the rocket arms.	Replenishment to be carried out through the lower threaded opening (through hole) in the high bank, before the outflow of oil from the holes in diametrically-opposing positions, which must be open. The tightening of nuts on the mushroom head spindle of the bumper fixture must be done to the full maximum (removing all clearances between the conjugated parts), after which make yet one more turn (until the buffer spindle apertures correspond to the nut grooves)
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(a)	(b)	(c)	(d)
2 contd.			and insert split pins. See Section: "Periodicity of mechanism lubrication"
3	Hydraulic shock absorbers	Check the existence of "free movement" of the lever. If necessary, repair ? replenish?	See Section "Maintenance of hydraulic shock absorbers"
		<u>Electrical Equipment</u>	
1	Electrical equipment	Inspect and test all contacts.	
2	Accumulators	Check the charge condition, level and consistency of electrolyte. Consistency of electrolyte must correspond to 1.29.	
3	Starter	(a) Check the fixing of the starter and leads. (b) Check the fittings with regard to coupling and mounting clearances. The radical clearance between the sides of cogs must be between 0.8 and 1mm. The facial clearance between cog faces must be between 4 and 5mm. (c) Remove dust from the commutator and brushes, removing the protective band to do this. Should the commutator be dirty, it should be rubbed with a clean rag, slightly damped in benzine, after which check the contiguousness of the brushes to the commutator. (d) Should the commutator be badly scorched it is essential to clean it with sandpaper No. 00 and then rubbed as described in sub-paragraph (c).	
		<u>Turret and Armament</u>	
1	Turret traversing mechanism	Replenish with oil	See Section "Periodicity of mechanism lubrication"
2	Gun	Oil the pivots	Ditto
		<u>Body</u>	
1	Locks, catches, hinges and hinge joints of all hatches of the turret body and equipment.	Inspect and if necessary clean and oil.	Ditto

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(a)	(b)	(c)	(d)
2	Covers of overflow hatches in the floor.	<p>Check the firmness of overflow hatches.</p> <p><u>Fire-fighting equipment</u></p> <p>Conduct an inspection of the PPO in accordance with Section III - "Maintenance of fire-fighting equipment"</p> <p>Inspect fire alarm in accordance with paragraph 4 of Section III - "Maintenance of fire-fighting equipment".</p>	<p>When changing cylinders check electric circuits in accordance with para 3 Section III PPO - "Testing of electrical circuits"</p> <p>Check the weight of used cylinders.</p>

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V. Periodicity of Mechanism LubricationGeneral Instructions

1. The lubricant used must be clean and not contain extraneous ingredients, such as: water, foreign substances, etc.
 2. Lubricant mixtures must be carefully mixed before use to obtain a homogeneous body.
- In winter, the lubricant to be heated.
3. Oil checks and replenishment should in winter be carried out immediately after runs before the mechanism has stopped.
 4. All mechanism and assembly lubrication points are shown in detail on the lubrication plan (fig. 19).

Lubrication Chart

A. After 1,000 kilometres

Para No.	Designation of assemblies, mechanism	Type of lubricant	
		Summer	Winter
(a)	(b)	(c)	(d)
1	Gear Box	Oil MT-16P GOST-6360-52 To a level of 60 + 2 mm - 1	
	Cranks	Lubricant UCo-2 100 grammes	Mixture: 50% UCo-2 and 50% Oil MT-16P GOST 6360-52.
2	Fan clutch bearings	Lubricant UT-1 GOST-1957-52 100 to 150 grammes	
3	Fan drive bearings on KPP (when there are lubricating holes)	Lubricant UT-1 100 to 150 grammes for each point	

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(a)	(b)	(c)	(d)
4	Disconnecting mechanisms of main clutch and blocking clutches PMP	Lubricant UT-1 75-100 grammes each	
5	Epicyclic gear mechanism	Mixture 30% lubricant UT-1, 70% oil MT-16P GOST-6360-52, quantity as required. The total quantity of lubricant put into each PMP is 2.5 litres, i.e. 0.75 Kg(sic) of lubricant UT-1 and 1.75 litres of oil MT-16P.	
6	Box Vertical Drive Shaft	Lubricant UT-1, 100-150 grammes.	
7	Driving gear hinge joints	Oil MT-16P	
8	Driving shaft supporting bearings	Oil MT-16P	
9	Quadrant	Oil MT-16P GOST-6360-52 to a level of 148 to 152 mm.	
10	Air-cleaner cassettes	After washing in diesel fuel the upper and middle cassettes to be oiled with oil MT-16P, 0.36 to 0.42 litres each.	

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B. After 2,000 kilometres
(with Technical Servicing No. 3)

(a)	(b)	(c)	(d)
1	Gear Box	Oil MT-16P GOST-6360-52	11 to 12 kilogrammes
2	Quadrant	Oil MT-16P GOST-6360-52	5.5 to 6.5 kgs
3	Epicyclic gear Mechanism	Mixture of 70% oil MT-16P GOST-6360-52 and 30% lubricant UT-1 The total amount of lubricant put into each PMP - 2.2 kgs, of which 0.7 is lubricant UT-1 and 1.5 kgs is oil MT-16P.	
4	Crank	Lubricant UCC-2-100 grammes, Mixture: 50% UCC-2 and 50% oil MT-16P GOST-6360-52.	
5	Turret traversing Mechanism	In the orifice, lubricate: Bearing, cog wheels and switch gear using 0.04 kilogrammes (first having removed the handle disc) in the event of dismantling of the traversing mechanism and the removal of lubricant from the housing? crank case?; the latter should be replenished with 0.75 to 0.8 kilogr. of lubricant.	

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(a)	(b)	(c)	(d)
6	Speedometer and tachometer cables	Oil MT-16P GOST-6360-52 20-30 grammes each in the casing.	50X1-HUM
7	Turret (a) Race, race cogs and turret catch. Commander's hatch race and turrets D Sh K. Fly wheel axis reservoir and sector cogs and pinions of D Sh K mounting. Slides of machine guns "SG". Pivots, sector cogs and pinion gear of the gun elevating mechanism. Cocking rollers of course (ordinary?) machine gun "SG" (b) All moving joints in the turret (apart from those listed in para "a").	TsIATIM-201 - for turret race - 0.5 kgs - for commander's hatch race - 0.3 kgs - for mounting race - 0.3 kgs Oil USs-2	
8	Rollers in rocker arm bearings (when dismantling unit)	Lubricant USs-2, quantity: 30-40 grammes	
9	Rocker sockets	The internal arm recess of the rocker to be filled with lubricant USs-2 to a quantity of 100-150 grammes.	
10	Suspension wheels and idlers	Lubricant USs-2 1. Put lubricant into every suspension wheel quantity 1200-1500 grammes. Of this quantity 100-150 grammes to go into each wheel bearing. 2. Put 750 grammes of lubricant into each idler. Of this quantity put into the idler bearings: 300 grammes into rollers 150 grammes into ball 3. The labyrinths of suspension wheels and idlers to be greased with lubricant USs-2.	
11	Side transmission	Replenish with lubricant TsIATIM 208 by VTU445-54. The quantity of lubricant for each side transmission - 4,500 grams of which 2,500 grams into the side transmission housing (gear box?) and 2,000 grams into the side transmission cover.	
12	Lubricating system	Oil MT-16P by GOST 6360-52. Put lubricant into the level of the red mark on the probe, which is equal to 60 litres (see chapter "Servicing the oil system")	
13	Fuel Pump regulator	Oil MT-16P by GOST 6360-52 Mixture: 50% oil MT-16P and diesel fuel.	

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(a)	(b)	(c)	(a)
14	Lubrication of belts	On machine, both those in use or in storage, all leather belts are periodically to be greased with ammunition grease GOST 2649-52. The frequency of greasing is set at not less than once a year	
15	Bolts, catches, hinges, and hinge joints of all body hatches, turrets and equipment	Oil MT-16P GOST 6360-52	

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VI. List of fuel and lubricants and special fluids used on tanks

Para. No.	Designation	When used	Observations
(a)	Fuel (b)	(c)	(d)
1	Diesel Fuel Mark "DL" GOST 4749-49	Summer	
2	Diesel Fuel Mark "DZ" GOST 4749-49	Winter	To be used in temperatures down to minus 30°C. May exceptionally be used in summer.
3	Diesel fuel Mark "DA" GOST 4749-49	Winter	To be used only at temperatures below minus 30°C.
	Lubricants (in pure form)		
1	Rifle oil GOST 3045-51	Summer	
2	Unified Tank Oil MT-16P GOST 6360-52	Summer and winter	
3	Lubricant UT-1 GOST 1957-52	Summer and Winter	
4	Lubricant USs-2 GOST 4366-50 with the following supplementary properties? pointers?	Summer and Winter	
	(a) Durability limit by? GOST 7143-54 at 50°C in g/sm ² , not less than 1 to 1;		
	(b) Effective viscosity by? GOST 7163-54 at 0 degrees centigrade and 10 seconds - 1 in intervals, not more than - 2,500.		
	(c) Ratio of effective viscosity at 0° and 50° to the speed of displacement? 100 seconds - 1 not more than - 20.		

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(a)	(b)	(c)	(d)
5	Gun grease GOST 3005-51	Summer	
6	Yellow Vaseline GOST 3581-47	Summer and Winter	
7	TsIATIM 208 by VTU 445-54	Summer and Winter	
8	Ammunition Grease GOST 2649-52	Summer and Winter	
9	TsIATIM 201 GOST 6267-52	Summer and Winter	
10	AZh-170, VTU No EU 109-55 MKh.	Summer and Winter	A working fluid only for hydraulic shock absorbers.
11	Steol "M" official fluid GOST 5629-40	Summer and Winter	
	<u>Mixtures</u>		
1	Unified Tank Oil MT-16P GOST 6360-52 - 70% Lubricant UT-1 GOST 1957-52 - 30%	Summer and Winter	
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2	Gun Grease GOST 3005-51 - 50% Oil MT-16P GOST 6360-52 - 50%	Winter	
	Cooling Liquids of Low freezing level		
1	Anti-freeze fluid Mark "65" GOST 159-52	Winter	
2	Anti-freeze fluid Mark "40" GOST 159-52	Winter	

Page 59Tank Maintenance Under Winter Conditions1. Individual Instructions regarding winter use of the Cooling System.

- When replenishing the system with cooling fluid the machine should be in a horizontal (to the eye) position;
- When the heater is operating the machine should be positioned horizontally (to the eye). The heater may operate with a tilt of the machine to any side of up to about 7°.
- When replenishing the system with cold anti-freeze, after filling the system run off 5 to 6 litres, in view of the appreciable expansion of anti-freeze on heating. The loss of anti-freeze (as a result of evaporation) to be replenished with water, periodically checking the density of the fluid in the system (in order not to allow great variations in density from that specified for a given type of anti-freeze, in accordance with its characteristics);
- When the engine is operating at low revolutions it is essential to pay attention to the water temperature on the dash-board thermometer. Should the water go below a temperature of plus 55° it is essential fully to close the exit louvres and go over to an increase in revolutions of the engine.

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Remember! Anti-freeze is a poisonous fluid and its entry into a stomach causes poisoning, normally with fatal consequences.

II. Tank injection Heater

1. Purpose, structure and operating principles of injection heater.

(a) Purpose of an injection heater.

An injection Heater serves to ensure the speedy starting of an engine and the maintenance of machines in a state of readiness to move in low temperatures of surrounding air. The pre-heater ensures the pre-heating of fuel, entering to feed the engine and fuelling the fighting compartment.

(b) Structure of the injection heater.

An injection Heater consists of the following elements:

1. Boiler
2. Reducer gear with electric drive.
3. Device for heating oil in the oil tank and in the pipe lead.
4. Pipe lead.
5. Coil for pre-heating fuel.

Boiler

The boiler (fig 1) consists of a welded cylinder, inside which is a cylindrical burner made of fire resistant non-rusting steel, joined to an exhaust chamber.

The fluid being heated fills the cavity of the boiler between the burner and external cylinder.

The combustion products leave the boiler externally through the outlet of the exhaust chamber in an aperture in the bottom of the body, covered by a special hatch (fig 3), which is opened and closed from the interior of the machine.

On the boiler there are two connections - for inlet and outlet of the cooling fluid, a connection for the supplementary outlet of exhaust when the machine is inclined on its "nose", and also a box, inside which is a coil for pre-heating fuel (fig. 1).

The furnace aperture of the boiler is covered by a cone cover on which are positioned the injector heater plug connection for the inlet of air from the reducer gear fan and inspection window (fig. 3)

For spraying the fuel in the boiler heater there is an injector pump of the centrifugal type, operating under a pressure of 10 to 12 atmospheric with an expenditure of fuel of 6.6 to 7.2 litres an hour (at 70-80 revs a minute of the handle of the hand drive).

(Sketches:

- | | |
|---------|---|
| Page 61 | Heating System |
| Page 62 | Reducer gear |
| Page 63 | Individual assembly units of the heater.) |

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Air, essential for full combustion of the fuel, is driven into the combustion chamber of the boiler by the reducer pump through a special inlet pipe, situated on the roof cone of the boiler.

The ignition of the fuel sprayed by the jet is effected by an incandescent spiral of an electric heater plug (fig 3) connected by a tumbler switch,

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Through this window it is also possible to ignite the fuel by means of a flame.

The boiler together with the reducer is set in the combat section of the machine on the floor, at the left side.

Reducer gear assembly with electric drive

The Reducer (fig. 2) consists of an assembly in which are mounted: fuel pump, fan, water pump and a manual(?) pinion drive. All this mechanism is built into an aluminium body, situated on the boiler.

- (a) Fuel Pump - plunger type (with the utilisation of one section of the engine fuel supply) serves for the supply of fuel to the boiler jet.

The fuel reaches the pump by gravity flow with simultaneous drawing off of the fuel by the reducer pump itself. The supply of fuel is from any group of tanks (forward, middle and external) of the fuel system through a specified tap, the coil of the fuel pre-heater, pump and coarse cleaning filter.

The supply of fuel to the pump is regulated with the help of a screw (4), acting on the pinion of the rotating case of the plunger. By turning the worm in a clockwise direction the supply is reduced and vice-versa.

Page 65. In the factory the pump is regulated to a supply of fuel of 6.6 to 7.2 litres an hour and is sealed in this manner.

Comment. For unfaltering operation of the reducer pump it is necessary that the group of tanks from which the feed is flowing, should contain not less than 20 litres of fuel.

- (b) Fan (2) of centrifugal type, serves for the supply of air, essential for the full ignition of fuel in the furnace of the boiler. The fan has a pulley service for the placing of the belt of the electric motor.
- (c) Water Pump (7) consists of a vane impeller of centrifugal type with five blades and serves for the forced circulation of fluid, heating the system.
- (d) Hand Pinion Drive to the Reducer (6) is for the bringing into action of the fuel pump, fan and water pump at the moment of starting and also for the operation of the heater from the hand drive. The drive consists of two pairs of gears. The first pair of gears, placed outside the reducer, transmits the rotation from the handle of the hand drive to the shaft with cogs and lugs, which drive the fuel pump plunger.

The second pair is fitted inside the reducer and transmits the rotation from the shaft with gears to the shaft on which the vane impeller of the water pump and fan are fitted.

The handle of the hand drive and the pinion gear of the first pair is made to be removable; when the pre-heater is not working it (the handle) is kept in the ZIP of the machine.

In operating the heater by hand drive the handle must be turned anti-clockwise at a speed of 60 to 70 revolutions a minute, in doing this the rotation must be even and can be done by foot as well as by

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hand. On the body of the reducer there is a plug for filling the cavity of the body with lubricant TsIATIM-201, 0.02 kgs.

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- (e) Electric drive to Reducer (8-9) serves to bring into action the reducer mechanism from the electric motor MV-42 and consists of a pulley with electric motor MV-42, fastened on a bracket and belt, transmitting rotation from the electric motor pulley to the fan pulley.

The fastening bracket of the electric motor has longitudinal sections for regulating the tension of the belt.

The starting tank (container) communicates with the basic through two apertures in the pan. The hot fluid from the coil of the oil tank goes to the external pipe, inside which the oil pipe from the tank to the engine passes through, ensuring in this way, the heating of the oil on its way to the oil main.

Pipe Line (fig. 1)

The heating system has two pipe lines: pressure and suction.

Pressure Pipe Line leads from the reducer water pump, goes to the head of the engine block and from there to the radiator and the coil of the oil tank.

Through the Suction Pipe Line hot fluid returns to the boiler from the coil of the oil tank and the engine water pump.

Through the outflow tap, fixed to the bottom of the machine, fluid flows out both from the engine and from the whole system.

The drive handle (?) is connected to the outflow tap with a tap cable and on the bracket of the pull (draught?) protector.

Coil for pre-heating the fuel (fig. 1)

The pre-heating of the fuel entering the engine fuel pump, and also the pre-heater reducer pump is effected by hot liquid, washing the fuel coil situated in a special box beneath the pre-heater boiler.

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The fuel goes to this coil through the fuel distributing tap from any group of fuel tanks and runs off to the lower connecting pipe of the "ALVEIR" (?), the filter for coarse cleaning and further, simultaneously to the engine and reducer pump.

(c) Operational principle of the injector heater

An injector heater works by means of an electric motor or hand drive, which causes the fuel to pass from the fuel tank through the injector to the boiler heater.

The fuel, on burning, gives heat to the fluid in the boiler. The heated fluid is drawn off the upper part of the boiler by the water pump of the heater whence it is fed through the upper (pressure) pipe lead to the pipe on the engine, which joins the head blocks (fig. 1)

From here the heated fluid branches out in three parallel streams.

/First

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First stream - going through the engine, washes and heats the heads of the blocks and cylinder blocks and goes to the water pump of the engine.

Second Stream - passing by the coil of the oil tank and the heating pipe of the suction oil mains, heats the oil in the booster (?) tank and mains and returns to the lower part of the boiler.

Third Stream - passes through the water radiator to the engine pump. From the engine water pump the fluid returning to the lower part of the boiler, heats up and begins anew its movement into the three streams mentioned.

In the summer period the boiler and coil of the oil tank are disconnected from the general cooling system.

The disconnection is effected by a tap (specially intended for switching over the boiler, depending on the period (time) of use), situated on the water pipe, uniting (joining) the heads of the engine blocks (see plan of heating system and plan of cooling system). REMEMBER! The use of the pre-heater when the tap is turned off is not allowed.

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(d) Starting the injection heater:

To start the heater it is essential:

1. Before starting the heater the switch tap must be on.

For this the tap handle must be turned as far as possible so that beneath the arrow "P" (=R latin) (view of the engine from above, see heating system plan or cooling system plan) on the face of the handle is the inscription "BKL" (=On).

REMEMBER! To simplify switching of the pre-heater tap it is essential beforehand to raise the plug of the tap by screwing on its shank the raising nut, after which the tap is switched.

Having switched the tap, it is essential to tighten the raising nut so that the free seating of the plug in the body of the tap is ensured.

2. Open the hatch in the floor for the outlet of combustion products by unscrewing the fastening nut of the hatch until it is arrested by the handle turned to the lower position (key is the ZIP of the engine), press down on it as far as it will go and turn the cover of the hatch beyond the handle for 180 degrees in a clockwise direction and put into place the hand drive handle.

3. Connect up the fuel distributing tap to any group of tanks for supplying fuel to the reducer pump and engine pump, pump with hand pump.

4. Press the tumbler to create a filament current for the pre-heater plug spiral, after which (after one minute) begins a slow rotation of the handle of the hand drive to the reducer in the opposite direction to that normally taken (the handle of the hand drive is not to be fastened).

Comment: In the event that it is impossible to turn the handle it is necessary to turn over the electric motor and reducer a few times by means of manual operation of the driving belt. It is also permissible with very low temperatures, to pour 25-50 grammes of diesel fuel into the reducer cavity (housing?) and also with the object of heating the electric motor to some extent and reducing in this connection the efforts for its rotation, to carry out the starting and short term (5 to 15 minutes) operation of the heater from the hand drive with the belt removed, subsequently going over to working from the electric motor.

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After firing, quickly change the direction of rotation of the handle to normal, connect the electric motor belt to the reducer and swiftly remove the handle of the hand drive.

When the heater is working from the hand drive the handle must be fixed and turned at a speed of 60/70 turns a minute (the electric drive belt is previously to be removed to reduce effort on the handle).

REMEMBER! In the event of a prolonged stoppage of the machine in low temperatures of surrounding air with accumulators fitted frequent and prolonged use of the electric drive to the heater reducer, without subsequent starting up of the engine, is **FORBIDDEN** - to prevent accumulators going flat.

5. With steady operation of the heated boiler (when the combustion of fuel in the heater can take place without the help of plugs), the plug tumbler switch must be disconnected, thus continuing the operation of the heater until the system is fully heated.

The normal operation of the heater is characterised by an intense rise in fluid temperature and by the colour of the exhaust gases, which after the heating of the boiler (after about 10 minutes operation) must not be deep black in colour.

6. After operation of the heater ceases the ventilator must be connected for 1 to 2 minutes to the engine partition.

Close the hatch for the outlet of combustion products, by turning the cover by the hatch handle anti-clockwise until the cover is level with the aperture on the base of the hatch on the axis until positioned vertically upward, and the removed handle of the hand drive to be laid in its place.

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2. Use of the Heating System

(a) The cooling system is supplied with anti-freeze. When the machine (vehicle) is halted for a prolonged stay in an open position it is essential to:

1. Position the vehicle horizontally (to the eye). The vehicle may have an inclination to any side of up to about 7 degrees.
2. Remove the accumulators and store in a warm position.
3. Close all hatches and louvres.
4. Cover over the engine cover and intake grill over the radiator with a warming rug.
5. Cover the vehicle with a tarpaulin and if possible cover the tarpaulin beneath the snow.

For the preparation of vehicles for movement after a prolonged halt in an open position it is essential to:

1. Place the accumulators in the vehicle.
2. Open the tarpaulin on the left side to allow exit for the exhaust gases from the heater and engine.
3. Bring the heater into action.
4. (a) In air temperatures down to minus 30° centigrade the warming up of the engine to be effected to a temperature of the cooling fluid of 80 to 90°C by the issue thermometer and, stopping the action of the heater give 5 to 10 minutes delay, during which, periodically and not more often than six times, for a short time (of 3 to 5 seconds) engage the electric oil pump to create pressure. When, according to the pressure gauge, there is a pressure of not less than one, atmospheric, press once for 3 to 5 seconds on the button of the electric oil pumping pump and starter, in this

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way turning the crank shaft a few times without supplying fuel.

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With an appearance on the oil metre of a pressure of not less than 2, atmospheric, the engine is started. If during the period of delay the electric oil pump in its periodic spells of engagement does not create pressure, according to the pressure gauge, - it is necessary to bring the heater into action, repeating all processes from beginning to end, as described above.

- (b) At air temperatures of minus 30°C and lower the warming up of the engine to be effected in two or three intakes bringing each time the temperature of the cooling fluid to 80-90°C according to the authorised thermometer. During this, after each intake (stage) give a 10 minute delay (stop the action of the heater) to ensure heat transmission to the crankshaft bearings.

After the second intake of warmth during the delay, periodically and not more often than six times for a short period of 3-5 seconds engage the electric oil pumping pump to create pressure. When, according to the pressure gauge, there is a pressure of not less than 1, atmospheric, the movement of the crankshaft and starting of the engine is conducted in full accordance with paragraph "a" of this section.

If there is still no oil pressure after the second intake of warmth from the engine, the engine is to be warmed up a third time, repeating fully the process of the second intake up to the starting of the motor.

Comment: With air temperatures of less than minus 40°C the starting of the engine (after it has been warmed) may be effected with the help of the starter and air starting device.

Remember! The electric oil pump may be kept on for not longer than one minute.

5. After starting the engine allow it to run on a basis of the minimum of steady revolutions until reaching an oil temperature (according to the authorised thermometer) of 8 to 10°C, and then go over to a basis of 1,200 to 1,500 revs/min. After the engine has warmed up the rug and tarpaulin are to be removed and placed in the vehicle.

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- (b) The water supplied cooling system.

When the vehicle is stopped for a prolonged period in an open position it is essential to:-

1. Place the machine in a horizontal (to the eye) position.
2. Close all hatches and louvres
3. Cover over the engine cover and intake grille on the radiator with a warming rug.
4. Cover the vehicle with a tarpaulin and if possible cover the tarpaulin beneath the snow.
5. Unscrew the plug (from?) of the drain off tap of cooling fluid under the bottom of the vehicle.

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6. Bring the water temperature in the lower part of the cooling system to between plus 40° and plus 50°C according to the thermometer in the pipe lead from the boiler to the drain tap
7. Unscrew the plug of the pouring throat of the water radiator (i.e. radiator cap).
8. Run off the cooling fluid. In doing this, having opened the tap, it is essential to ensure a continuous flow of drain off water. If this does not take place the pipe lead must be pulled towards the tap to ensure an intensive flow (with a fully opened tap the water should drain from the system in 8 to 12 minutes).
9. Leave the drain tap and radiator cap open throughout the period the vehicle is halted.
10. Remove accumulators and store in a warm place.

Comment: After draining the water from the system it is advisable to pour not less than 3 litres of anti-freeze into the radiator. If this is done as soon as the anti-freeze begins to run from the drain aperture the drain tap must be shut.

Page 73To Prepare the Vehicle for Movement after a Prolonged Halt in an open position

1. The vehicle to be put in a horizontal (by eye) position in positioning the machine a tilt of up to about 7° is permitted on any side.
2. Open up the tarpaulin at the left side for the outlet of exhaust gases from the heater and engine and for access to the water radiator.
3. Replenish the cooling system. In doing this, if the surrounding temperature is not lower than minus 25°C, the replenishment of the system with water heated to a temperature of plus 70 to plus 80°C is allowed.

To avoid freezing in the radiator the replenishment with hot water must be conducted quickly and without stops, in the shortest period of time. After beginning the pouring in of the water the drain tap is to be opened and, as soon as a regular stream of water begins to flow through the drain aperture, the tap must immediately be shut off again. After this another 30 to 50 litres of water must be poured in and the heater brought into action, as described in para "d", page 68.

When starting the heater or immediately after, the system must be fully filled with water and the radiator cap and drain tap (on the bottom of the vehicle) must be fully screwed home and under tap plug a spring washer is to be placed.

It is forbidden to pour boiling water into the system.

REMEMBER! If the surrounding temperature is less than minus 25°C, replenishment of the cooling system may only be effected by means of anti-freeze (cold or hot).

In starting the engine a situation is possible where the reducer-gear handle does not turn. This occurrence may be as a result of the freezing of the vanes of the reducer water pump consequent upon an incorrect positioning of the vehicle whilst draining off (with a considerable tilt to the stern or on the right side).

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In this case it is necessary to act in the following way: hot anti-freeze at a temperature of plus 50 to plus 80°C is poured in in such a quantity that the rotation of the reducer handle (arm?) is ensured. The remaining quantity of anti-freeze is poured in cold. It is essential to shut off the drain tap as soon as the anti-freeze begins to flow from the drain aperture.

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Comment: If, in pouring cold anti-freeze into the system (after closing the drain tap) the anti-freeze continues to run from the drain aperture of the tap, because the valve is not lying properly in its socket due to ice on the extremity of the interior of its body, it is permissible to heat the tap (by a flame under the bottom).

4. The warming up and starting of the engine is to be conducted according to point 4 of the section "Use of the heating system".

When stopping the vehicle, supplied with water, for a short halt outside a warmed place and with a necessity to maintain the engine in a condition to ensure its speedy starting, - IT IS ESSENTIAL:

1. Place the vehicle in a position horizontal to the eye, a tilt of up to about 7° on any side is permissible.
2. Warm the machine, as described above, pulling aside the tarpaulin at the left side, to allow outlet of exhaust gases from the boiler.
3. When the water temperature goes down to plus 40° according to the issue thermometer, bring the heater into action, as described in section "d"

Heat the water in the system until a temperature of plus 80 to 90° is reached, after which stop the heater action.

4. Each time the water temperature falls to plus 40°C it is necessary to begin anew as described in point 2 and to repeat this throughout the period the vehicle is halted.

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3. Maintenance of the Heating System

A. Maintenance

1. The boiler is cleaned once a year, after winter use, but not less frequently than after 40 to 50 hours of heater operation the boiler is cleaned of the products of the fuel that have not fully been burned out. The cleaning covers: furnace, chamber and internal space of the cone cover with jet, plug and pipe. (To determine the times of cleaning the boiler the length of time it is operating should be noted in the vehicle formula work book). The cleaning to be carried out without removing the boiler from its base. The cleaning to be done by scraper and ramrod. When preparing the tank for winter use the boiler is to be cleaned irrespective of the number of hours it has operated.

2. Preparatory work and the Cleaning of the Boiler.

As a preliminary it is essential to remove:

- (a) The lower fence (protector?) (of the engine).
- (b) The fuel pipe going from the reducer gear to the jet.
- (c) Disconnect the lead from the heater plug.
- (d) Relax the tension of the band pressing around the rubber hose on the air pipe of the boiler cone.
- (e) Remove the cone cover of the boiler, first unscrewing the nuts and bolts with which it is fastened.
- (f) Open the hatch cover of the pre-heater exhaust outlet.

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To clean the internal cavity of the boiler it is essential to turn the ramrod handle to the free place which is between the coarse cleaning fuel filter and the fuel distributing tap. Then place the ramrod beneath the engine crank case and from this position do the cleaning, directing the end of the ramrod until it meets resistance at the rear wall of the boiler heater.

The removable cone cover to be cleaned with a scraper.

The exhaust outlet (pipe?) to be cleaned of soot, by lightly tapping around or cleaning from below the scraper.

Having cleaned the soot from the boiler it is necessary to reassemble it consecutively in the reverse order to dismantling. After cleaning the boiler, close the hatch.

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3. Lubricating the Reducer

Combine the lubrication of the Reducer with the cleaning of the boiler by replenishing the cavity of the Reducer with 20 to 30 grams of lubricant TsIATIM-201. Also, during the time the heater is operating it is essential periodically to lubricate with the same lubricant the bush (sleeve?) of the crank case into which the axis of the pinion of the hand drive (starter?) is put.

B. Faults

1. If after connecting the tumbler the plug spiral filament and the initiation of rotation of the heater arm (handle?) do not work, it is necessary to:

- (a) Check the presence of the plug spiral filament through the inspection window of the boiler cone cover. If there is no filament check the electric circuit. If the latter is in order, then the plug must be unscrewed and the spiral inspected. If burnt out, replace.

Comment: In the absence of a servicable plug, ignition can be effected by an open flame (a stick with a burning end or piece of fibre) which is put through the inspection window, at the same time turning the handle.

- (b) Check the intake of fuel to the Reducer-gear pump, for which, ensuring that in the tanks which are connected up there is not less than 20 litres of fuel, unscrew for 3 to 5 turns the bolt releasing air from the Reducer pump and pump the hand pump until a steady flow of fuel comes from beneath this bolt. Then turn the bolt as far as possible and swing the handle of the ALVEIR (?) two or three times.

If there is less than 20 litres of fuel then connection should be made to tanks with a greater amount of fuel.

If fuel is reaching the pump but the jet is, nevertheless, not working it is necessary to check the operation of the pump. For this the nut of the pressure pipe must be unscrewed from the connecting pipe of the pump fuel element; on turning the Reducer handle (arm?) the fuel should, with a serviceable pump, flow out in a stream.

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An obstruction of the jet, as a rule, will prevent the possibility of the Reducer handle (arm?) being turned. In this case, the jet must be replaced or cleaned. To clean the jet, it must be taken apart and each item washed in clean fuel. When re-assembling and re-positioning the jet particular attention must be paid to the correctness of assembly of the jet, remembering how the bits were positioned in the jet before dismantling and making use at the same time of the plan in this instruction (fig 3)

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2. Fluctuating in the operation of the heater on starting, and when there is sufficient fuel in the tanks, may also be the result of the intrusion of air from the fuel system into the Reducer fuel pump.

The air is released from the Reducer pump by unscrewing for 3 to 5 turns the air release bolt followed by pumping of the hand pump until a steady stream of fuel comes from beneath this bolt, without air bubbles. After this the bolt must be tightened until it meets resistance and the pump pumped two or three times with the handle.

If it is necessary to bring the heater into action or to go over from one group of tanks to another when there are small (inaccessible) quantities of fuel in them then, after connecting the fuel distributor tap to one or another of the groups of tanks the tap for air release from the oil system (situated on the beam of the engine guard) must be opened and keeping it in the open position, pump the hand pump until the connected pipe lead is completely full of fuel. After this the above mentioned air release tap is closed and the heater started. If on doing this the heater does not start because of lack of fuel supply to the jet then it is necessary to release the air from the Reducer pump by unscrewing the bolt and pumping the hand pump without opening the air release tap.

3. If the heater exhaust gases continue to come out in a deep, black colour after about 10 minutes of operation this testifies to insufficient heating of the fuel in the boiler.

The latter can take place:

- (a) With poor suction of fuel by the jet which gives a flowing stream or a stream of copious drops. Such a jet must be changed.
- (b) If there is heavy scale in the interior of the boiler. This must be removed by cleaning.

To reduce the development of scale inside the boiler rotation by the use of the handle must not be allowed without necessity; handle turning to be begun only after the plug spirals are fully heated.

- (c) If there is disruption of the adjustment of fuel supply to the Reducer pump when, instead of the normal outflow of 6.6 to 7.2 litres of fuel per hour the outflow is appreciably greater.

Disruption of the adjustment can only occur if there is a break in the locking wire, holding the regulating thread of the pump against forced rotation of this thread.

In this case the pump must be readjusted to give normal supply and the thread fitted with a locking-wire and a seal put on. Adjustment of the pump can only be carried out by qualified personnel.

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Maintenance of the Tank's Fire Fighting Equipment (PFC)

1. Purpose, structure and operating principles of fire-fighting equipment

1. Purpose of the Tank's fire-fighting equipment.

The fire fighting equipment of a tank consists of a fire-fighting carbonic acid unit, designed for extinguishing fire in a tank by filling with carbonic acid gas all the free space of that section of the tank in which the fire starts.

2. Structure of PFO.

The fire-fighting equipment (fig 4 and 5) consists of the following elements (units):

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- (a) Three cylinders of 5 litre capacity containing carbonic acid, situated in the combat section of the right side of the body, near the engine guard.
- (b) Two main pipe leads, joining the cylinders with the combat and engine-transmission sections, each main terminates with four outlet spray nozzles, situated in the following places:

In the combat section - two (in the nose portion of the hull), between the ammunition store and fuel tanks) and two on the engine guard (at the sides).

In the engine-transmission section - one at the nose of the engine, the second at the left side between the engine and the fuel tank and two in the stern part behind the KPP (by the TMP).

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- (c) Six thermo-electric alarms (i.e. informers) - situated by, and on the same brackets as the spray nozzles. There is no alarm on the engine guard TT.
- (d) The Signal board of the driver, fitted with two signal lamps, two buttons intended for extinguishing fire in the engine in transmission and combat sections and one button for checking the serviceability of the lamps.
- (e) Buttons, duplicated, positioned on the under-turret sheet, in line with the right ceiling for extinguishing fire in the combat section.
- (f) Signal whistle, situated in the nose section of the hull.
- (g) Switch-meter positioned above the carbonic-acid cylinders.
- (h) Special electric leads (wiring systems?) with two double clamping transportable boxes.

Operating Principles

Each carbonic acid cylinder PPO (fig 7) is equipped with a special head with two sleeves (connecting pipes?) one of which is joined to the pipe lead of the combat section, the other with the pipe lead of the engine-transmission section. Each of these sleeves is separated from the cavity of the cylinder with its carbonic-acid membrane (6), fastened by plugs into which are built pyro-cartridges PPZ(12) and a plunger-piercer (5).

When extinguishing a fire by the pressing of the button, to the electric fuse of the appropriate pyro-cartridge an electric current is led. The pyro-cartridge explodes and the pressure of gases forces the plunger-piercer to pierce the membrane. Through the aperture made in the membrane the carbonic acid surges from the cylinder in the appropriate main to the seat of the fire.

These plans as Follows:

Page 81: Main Plan of Fire Fighting Equipment.

82: Positioning of Fire Fighting Equipment

83: Switch-Meter

84: Carbonic Acid Extinguisher and spout for charging

85: PPO Signal Board

86: Thermo Electric Alarm and Outlet Pipe.

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For informing the crew that a fire has broken out in the combat or engine-transmission section, there are appropriate signal lamps, situated on the signal board (see fig. 8), and also a signal whistle (siren?) which operates only in the event of a fire in the engine-transmission section.

In the combat and engine-transmission sections six thermo-electric alarms are situated in various places. They are linked to the electric circuit of the appropriate signal lamp. Each thermo-electric alarm (fig. 9) is fitted with a special bimetallic membrane (4) which bends, when the temperature rises (on the outbreak of a fire) and the contacts join (1 and 6) completing the electric circuit of the appropriate signal lamp. To extinguish the fire it is necessary to stop the engine; on the signal board the button of the signal lamp which has lighted up, must be pressed.

The checking of the effectiveness of signalling lamps (lights?) and electric circuit is done with the help of a special button (5) situated on the signal board (fig 8). Signal lamps that are in working order must light up when the button in question is pressed.

To extinguish a fire in the combat section, apart from the button positioned on the driver's signal board there is also a supplementary (duplicate) button, situated on the leaf (sheet?) under the turret, in line with the right ceiling.

The engagement of the electric fuses of the appropriate cylinders when pressing the fire extinguishing button (see fig. 4) is effected through the switch-meter (fig. 6) to the terminals of which - "B" (Combat Section) and "T" (engine-transmission section), the appropriate extinguishing buttons are connected. These terminals, through oscillating contacts fastened on the movable disc of the switch (4) complete circuits (join?) in turn with the contacts which are connected by leads with the pyro-cartridges on the appropriate sides of the cylinder caps 1B, 2B, 3B (for the pyro-cartridges and membranes operating on the combat section) and 1T, 2T, 3T (for the pyro-cartridges and membranes, operating on the engine-transmission section).

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Switch-meter (fig. 6) operates in the following way: when the button is pressed the electric circuit of the appropriate pyro-cartridge fuse is completed through the terminal "B" or "T" (fig. 4) and the oscillating contacts of the movable disc. At the same time the relay in the switch-meter (15) is engaged - the relay armature retracts and, rotating the jaw pawl(?) (5), moves the catch (2) on to the next cog of the ratchet (2') which is positioned on the same axis as the movable disc and the sector (7) reading the quantity of used cylinders. On releasing the button the relay is disconnected and the armature, acted upon by the spring, returns to its original position, pulling through the pawl and ratchet catch with movable disc and sector. In this the oscillating disc contacts complete the contact of the pyro-cartridge of the next cylinder and thus prepare it for action; the sector for reading the number of used cylinders with the numbers marked on it turns and against the "eyelet" (2') - (opening in the frame of the switch-meter) the next number appears, showing the number of used cylinders.

The extinguishing of fires in both sections simultaneously must be effected only by successive pressure on the buttons.

REMEMBER! SIMULTANEOUS PRESSURE ON BOTH BUTTONS IS FORBIDDEN, since in doing this the two pyro-cartridges of one car will operate and pierce both the membranes, causing the pipe leads of the engine-transmission and combat sections to join up through the used cylinder and with the next extinguishing of fire the carbonic-acid, irrespective of the button connected, will go to both sections.

The charging of the PPO is done by a regular current of 24 volt pressure, entering the signal board of the PPO and the button on the leaf below the turret in line with the right ceiling, from the terminals on the protective blocks of accumulators.

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Page 89II. Use of Fire-Fighting Equipment

1. In extinguishing a fire the driver must first stop the engine and then press the button on which the signal light is burning (on).

The button must be pressed to the full and quickly released.

The button should not be kept for a prolonged period in the engaged (pressed) position.

2. If after pressing the button and the exhaustion of the cylinder the signal light goes out - this is a sign that the fire has been liquidated.

If the signal light continues to burn, this means that the fire has not been extinguished and it is necessary to repeat the extinguishing operation, i.e. the button must again be pressed.

3. If there is a simultaneous fire in the combat and engine-transmission sections, both lights will go on on the signal board.

In this case, to extinguish the fire it is necessary to press both buttons in turn.

REMEMBER: SIMULTANEOUS PRESSURE ON BOTH BUTTONS IS FORBIDDEN, since in doing this the two pyro-cartridges in one cap will operate and pierce both membranes, causing the pipe leads of the engine-transmission and combat sections to join up through the used cylinder and when the next extinguishing of fire takes place the carbonic-acid irrespective of the button pressed, will go into both sections.

Pressing the two buttons in turn, apart from what has been said, also ensures the effective extinguishing of a fire since it will take place in each section from a separate cylinder.

4. The extinguishing of a fire in the combat section can also take place with the pressing of button PPO on the sheet beneath the turret, in line with the right ceiling.

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5. If the number "3" is shown in the "eyelet" of the switch meter this means that all three cylinders have been exhausted and they must be changed.

6. THE CREW AND MAINTENANCE STAFF MUST REMEMBER THE FOLLOWING:

- (a) Properly operating fire fighting equipment is an effective instrument for extinguishing fires which break out in the vehicle, in this way safeguarding both the crew and the vehicle.
- (b) Carbonic acid streams from a single cylinder for 40 to 50 seconds, the extinguishing of a fire takes 8 to 15 seconds
- (c) When the carbonic-acid comes to the end of its outflow a great concentration of it is formed in the lower part of the hull of the machine and, therefore, after liquidating the fire in the combat section and driving section it is essential to ventilate.

A prolonged spell in the lower part of the hull from which carbonic-acid has not been removed can lead to loss of consciousness.

The driver, situated lower in the tank than other crew members must, on the exhaustion of the PPO, open the ventilating hatch in the driver's hatch cover and breath through it.

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- (d) The operational effectiveness and preparedness for action of fire-fighting equipment is ensured by systematic inspection and correct maintenance.

III. Maintenance of Fire-fighting equipment

1. General Instructions regarding the inspection of machines.

It is essential to check by external inspection:

- (a) The presence of seals on the caps of extinguishers (cylinders) and signal board.
- (b) The presence of cellophane protectors on the buttons (on the driver's signal board and in the turret).

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- (c) The serviceability of electric leads (absence of damage).
- (d) Serviceability of the signal lights and signal whistle.
- (e) Number of used cylinders (in this connection it is CATEGORICALLY FORBIDDEN TO TURN THE NUMBERED SECTOR).
- (f) Fixing of pipe leads and electric leads to the carbonic acid extinguishers and to the contact buttons of carbonic-acid fittings.
- (g) Absence of pieces of waste and rags in the combat and engine-transmission sections.

2. Maintenance of Carbonic-Acid Extinguishers.

After every 10 to 12 months of storage and use of cylinders they must be subjected to inspection weighing.

The weight of carbonic acid with which the cylinder is charged must conform to the inscription on the stencil and must not be less than 1.8 kgs. If the contrary is the case the cylinder must be re-charged or exchanged for one that is charged.

With repeat charging of a cylinder with carbonic acid the weight of the charge of carbonic acid and the date of weighing must be entered in paint on the cylinder stencil. Analogous entries are to be made in the tank log book.

Charged carbonic-acid extinguishers of the company set ZIP to be stored in a dry place with a temperature not higher than plus 40°C.

To change cylinders in a machine it is necessary:

- (a) Connect the "mass".
- (b) Unscrew the covering nuts (fig. 7), disconnect the lead and cover the ends with insulating tape. If the covering nut (item 59.318) should unscrew together with the plug (item 59.326-1), the latter must be held from unscrewing by item 59.332-2 flat nut spanner with (from?) C-11.
- (c) Disconnect the pipe leads from the pipes (connectors?) of the extinguisher.
- (d) Remove the cylinder and in its place put a new one with a normal charge and fasten it firmly with its fastening bands.

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- (g) The joining of leads from the switch-meter (after checking that the circuit is in working order) is done in the following order: leads with tags "87", "86", "85" (3B, 2B, 1B) to be joined with cap cartridges on the side of the nose of the machine (vehicle?), leads with tags "88", "89", "90" (1T, 2T, 3T) to the cap cartridges on the engine guard side.

Subsequently the paired leads "3B" and "3T" are joined to extinguisher No. 3 (the first from the vehicle nose), leads "2B" and "2T" - to extinguisher No. 2 (middle) and leads "1B" and "1T" - to extinguisher No. 1 (by the engine guard).

The leads must be joined according to the plan (fig. 4)

- (h) Position the pipe leads, effectively tightening the connector nuts and checking the presence of packing layers in each connection.

3. Checking Electric Circuits

To check PPO electric circuits it is necessary to:-

- (a) Disconnect the "mass" and disconnect the lead from the cap.
- (b) Attach an electric lamp to the end of each lead.
- (c) Connect the "mass". When this is done the lamps on the ends of the leads and on the signal board should not light.
- (d) When the button in the combat section is pressed the lamp on the end of lead "85" (1B) should light up. On releasing the button the lamp should go out and the switch meter must show the figure "1" in the "eyelet".

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When this button is pressed a second time the lamp on lead "86" (2B) should light up and on release of the button, should go out while the switch-meter must show the figure "2" and so on.

In this way it is necessary successively to check from the buttons on the signal board both groups of lead - the combat and engine - transmission sections, and also the working order of the combat section leads from the buttons on the sheet beneath the turret, in line with the right ceiling.

REMEMBER! On pressing one and the same button extinguishers No. 1, No. 2 and No. 3 must operate in turn. Discharge must take place in that section on the button on which pressure is put.

- (e) Checking on the presence of contact between the pyro-cartridges and the leads connected to them on the cylinder caps is carried out, with the engine not operating, in the following way:

Check the effectiveness of the protector (fuse?) 80A in the charging circuit in the protective blocks of accumulators (terminal No. 3).

Connect the disconnecting switch of the mass. On the switch-meter place the sector with numbers in position "0" by turning clockwise beyond the slit of the spindle with ratchet.

On the rear panel of the PPO signal board turn the wing nut and remove from the bolt the lead which shows the minus of the volt meter (volt ampere metre) on the driver's electric instrument board.

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the tip of this lead to be laid in line with the outlet contact bolts No. 1 and No. 3 of the PPO signal board, at the same time pressing the volt ampere meter button on the driver's electric instrument board. Deflection of the volt ampere metre arrow when this is done, shows the presence of contact between the pyro-cartridge and lead.

After this, on the switch-meter place the sector with numbers in turn in position "1" and "2" and on each of them repeat the tests in the order described above.

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After finishing the tests put the sector with numbers in position "0".

Put the tip of the volt ampere metre minus lead on the bolt on the PPO signal board and tighten it with a wing nut.

4. The testing of the operation of the thermo-alarms is conducted as follows:

1. Beneath one of the TEIzv (i.e. Thermo electric alarms) of the combat section place a special source of heat. At this, the signal light over the button "in the combat section" must go on. When the source of heat is removed the light must, after some time, go out. In this way check in turn all the TEIzv of the combat section.
2. An analogous test of thermo-alarms is conducted in the transmission section, when the signal light above the button "in the engine-transmission section" must go on and the PPO signal must sound. In testing the TEIzv of the transmission section, to protect the signal from burning out, it is essential not longer than 30 seconds after completion of the circuit to disconnect the disconnecter of the "mass" and periodically connect it for 3 to 5 seconds before the circuit (TEIzv) is broken. In this process the total time that the TEIzv combat and engine sections are connected up must not be more than eight minutes.

5. Charging Carbonic-acid Extinguishers

Carbonic acid extinguishers are charged with liquid carbonic acid from cylinders of large capacity with the aid of a special pump or transfusion, ensuring in the latter case the refrigeration (condensation?) of the cylinder being charged.

Charging by transfusion is carried out in the following order (fig. 10).

Unscrew the stopper in the cylinder cap.

Set the special lever (screener?) (fig. 7) with washer (1).

Suspend (weight?) the cylinder and fitted key (fig. 10)

The carbonic acid cylinder (1) of large capacity (40 to 50 litres) to be placed valve down (fig. 10).

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Unscrew one of the stoppers with a spanner (4) join by a pipe (2) the key (?) connector with the cylinder.

The cylinder together with key (?) to be placed in a cooling medium (in a bucket of snow or cold water), put on scales and weighed.

With the spanner lever (4) (fig. 1) screw up the connector (5) to the full.

Fully open the valve of the large cylinder and then unscrew the connector (5) and begin the filling of the cylinder with carbonic acid.

Fill the cylinder with carbonic acid until its weight increases by 1.8 to 2 kgs. On completion of charging tightly screw up the connector (5) and valve of the large cylinder.

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Carefully disconnect the pipe (2) (fig 10) from the connector of the key (?) and suspend (weigh?) the cylinder together with the key (?).

If the weight of carbonic acid exceeds 2 kgs - let out the surplus.

Remove the key (?) from the cylinder cap, test the cylinder for hermetic sealing greasing junction places with soapy water, but not allowing any bubbles.

Put a washer (packing?) on the connector and tightly fasten with a stopper (9) (fig 7).

The weight of the cylinder and carbonic acid and the date of charging to be written in paint on the stencil (?) on the body of the cylinder and in the tank log book of the PPO, attached to the machine.

Page 96Plan of Fire-Extinguisher ChargingPage 97Maintenance of Hydraulic Shock Absorbers

Maintenance of Shock Absorbers consists of inspection of the completeness of filling and of their fixing to the body of the vehicle.

The fixing of a shock absorber is tested by external inspection - tapping of the heads of bolts with hand hammers. An insufficient amount of fluid in the hydro shock absorber is detected by a presence of "free movement" in the arm of the hydro shock absorber or the presence of a leak of the working fluid from beneath the rubber cuff or seams of joints. If a leak is discovered the hydraulic shock absorber must be removed from the vehicle for servicing. After being removed the hydro-shock absorber must be laid in a horizontal position with the cover "4" (fig. 11) upwards, remove the cap and change the defective item. If the rubber cuff "5" has to be changed it is essential to ensure tight pressure of its flange between the cover "4" and the face of the neck of the baffle (diaphragm?) "8". The size of the compression of the cuff flange must be between 0.4 and 1.2 mm and is regulated by the appropriate assembly of washers "6". If the washers "6" have to be changed then select an assembly of washers such as will in their thickness match the thickness of the washer being changed.

Before being fitted the washer must be smeared with a thin film of whiting or red-lead. If there is a leak of working fluid from the hydro-shock absorber through washers "7", the baffle(?) "8" must be removed and the washers changed; the thickness of the assembly of washers being fitted must be from 25 to 30% bigger than the clearance between the face of the body "9" and the flanges of the baffles "8" (when the baffles are pressed against the bottom of the body). The clearance is to be measured in four, diametrically opposing places, two of which must be in the middle of the fists (?) of the baffles. Before fitting the washers must be smeared with a thin film of whiting or red lead.

The bolts must be equally tightened to the full.

Page 98 Sketch Fig. 11. Hydraulic Shock Absorber

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In this connection the clearance between the flanges of the baffles and body, measured by clearance gauge through the grooves in the washers, must correspond with the clearance obtaining before the washers were fitted, or less (smaller?) than this clearance, but not more than 0.05mm.

The aim of the hydro-shock absorber to be pressed on to the splines of the vane so that the graduation lines on the face of the vane and arm coincide.

The correctness of assembly to be tested by turning the vane "10", which should freely revolve by hand. If there is no leak, the level to which the chamber of the hydro-shock absorber is filled with working fluid must be determined by disconnecting the arm of the hydro-shock absorber from the rocking shaft and rocking it a few times from one extreme position to the other (until the vane comes up against the baffle).

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If the arm goes some of the way without resistance (easily, without meeting resistance from liquid), and the extent of the "free movement" of the arm is more than 30mm (in measuring at the end of the arm) and is not the result of the gap of the arm on the splines, the hydro-shock absorber must be replenished.

For this purpose the plugs "2" and "3" must be unscrewed and, with the aid of a funnel, replenishment of the hydro-shock absorber fluid should be made slowly, through the aperture of plug "2" (holding the funnel suspended so that it does not overlap the aperture) rocking the arm from one extreme position to the other.

The replenishing to be carried out until fluid shows from the aperture under plug "3" which indicates that the hydro-shock absorber is fully replenished.

After this the plug "2" must be screwed up to the full extent; in the aperture under plug "3" screw in the hose connector from the screw syringe-press, place a measuring dish under the free end of the hose and slowly raise the arm of the hydro-shock absorber from the bottom upwards until 90 cm of the fluid has been drained from the hydro-shock absorber. The free end of the hose must then be raised upwards and, slowly moving the arm downwards, transfer the fluid contained in the hose to the hydro-shock absorber.

After this, unscrew the hose, screw up plug "3" to the full and split pin the plug.

The hydro-shock absorber is filled with a mixture consisting of 90% saponified glycerine OCT NKPP-532 or technically distilled glycerine, 1st or 2nd type (textile) OCT NKPP-533 and 10% of spirit of raw ethyl GOST 131-41 or spirit of rectified ethyl OCT NKPP-278.

Structure, Use and Maintenance 3A Electric Drive EPB-4

1. General Information

The main drive for rotating the turret is electric drive EPB-4 with a double drive system. The electric drive is intended for the horizontal directing (aiming) of a gun on to a target by the gun commander and also by the tank commander. The control of the electric drive by the gun commander is effected by controller KB-4. The direction of rotation of the turret is determined by turning the control handle to the right or to the left from the original vertical position.

The speed of rotation of the turret grows with the increase of angle of deflection of the handle. The electric drive, having wide limits of smooth adjustment of the turret's speed: from 0.1°/second to 5.5°/second, with a staggered transfer to maximum speed in 10°/seconds ensures precise horizontal direction of the gun on to the target by the gunner. The gunner's control of the electric drive disconnects automatically, if the tank commander takes over control, when the handle key of the turret rotating mechanism is released. The control of the electric drive by the tank commander is effected with the help of the commander's control system. The direction of rotation of the turret is determined by turning the cover of the commander's hatch to the right or to the left from the original position (hatch or catch).

If the tank commander, releasing the hatch catch and turning the hatch by means of his sighting instrument in the direction of the target and holding it on the target, presses the button in the handle of this sighting instrument, then the electric drive will begin to turn the turret at the maximum speed 10°/second in the direction and at the same angle as that on which the commander's hatch cover has been turned. When the gun axis coincides with the sighting line of the commander's sighting instrument the electric drive automatically disconnects and the turret stops.

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II. Description of Structure

Electric drive EPB-4 includes the following units: Motor-generator AB-64, rotation motor MPB-54, controller (control device?) KB-4, starter switch gear PPU-2, filter FG-57, commander's control system and inter-locking gear of the hand drive turret traverse, electrically joined together according to the principles of the sketch (fig. 12).

1. Controller KB-4 is intended for the control of the electric drive by the gun commander, KB-4 consists of an apparatus comprising an electro magnet relay, systems of movable and immovable contacts, rheostat block (?) and pressure regulator. The controller provides for changes in speed by changing pressure, developed by the AB-64, and the direction of rotation of the turret by changing the direction of the current in the shunting coil (?) MPB-54 and the control of fire of the co-ax machine gun by a button in the controller handle. The controller is situated on a bracket fixed on a runner in line with the rotating mechanism.

2. Starter switch gear PPU-2 is used for connecting the electric drive to the battery and switching the rotator motor of the turret MPB-54 at the maximum rotation speed.

Page 102: Basic Plan of Electric Drive EPB-4

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The PPU-2 consist of an apparatus, comprising three strong current relays, one weak current relay and actuator (starter?) resistance. The PPU-2 is situated under the controller on the same bracket.

3. The motor-generator AB-64 is for converting the constant voltage of the accumulator battery to the regulated voltage necessary for feeding motor MPB-54 with the smooth change in the speed of turret rotation.

The AB-64 consists of an assembly comprising two similar four terminal electric machines or direct current of shunt excitation, situated in one common body, the armatures of which are situated on the general shaft.

One side of the assembly is worked by motor and the other by generator.

The AB-64 is positioned on a special cushion fixed to the ground sheet (of metal) beyond the "controller".

4. The electric motor MPB-54 is used for bringing into action the rotation mechanism of the turret from the motor generator AB-64 or from accumulator batteries.

The MPB-54 consists of a four polar reversible motor of direct current of shunt excitation. The MPB-54 is fixed on the crank case of the turret rotation mechanism.

5. The filter FG-57 in the structure of the electric drive is used for suppressing radio frequency interference, created by the electric drive units.

The filter FG-57 is fixed to the left wall of the turret on the motor generator AB-64.

6. The system of commander's control of the turret rotating electric drive includes the following:

- (a) Terminal Switch Block PC-3, used for preliminary preparation of the electric drive system, for turning the turret to one direction or another, by the tank commander.

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The terminal switch block is a bracket assembly on which are mounted switches PC-3 and a lever with a roller, on the lower part of the lever a cog (cam?) is welded which, when the lever is turned to one side or another forces out the coupling rod of one or the other switch and in this way engages the switches.

The terminal switch block PC-3 is situated on the inside of the turret cover behind the tank commander.

- (b) The Copying (duplicating?) installation is for engaging and disengaging terminal switches. The copying installation is a smooth cylindrical surface, situated on the external side of the runner of the block of the commander's hatch cover, below the ball runner tracks. In one place on this cylindrical surface there is a radial recess in which, in the initial position (hatch fastened) the roller of the terminal switch block lever.
- (c) The ring (cyclic?) contacting installation, consisting of two rings and two brushes intended for the supply of pressure (voltage?) to the side system from the turret in the rotating cover of the tank commander's hatch on button 205-K. Contacting rings are situated in a special seating in the block runner of the commander's cover, and the brushes are on the inside of the turret cover in line with the terminal switch block.
- (d) Button 205-K, built into the left handle of the tank commander's sighting instrument enables the tank commander to switch on the electric drive.
- (e) Locking gear of the hand drive of the turret-rotating mechanism, ensuring that the tank commander cannot switch on the electric drive while the gunner is operating the turret rotating hand drive.

The hand drive locking gear consists of a contact ring and brushes, situated on the crank case of the rotating mechanism and is electrically connected: from one side with the FPC-2, switching on the electric motor, and from the other side with the moving contact of the rotating mechanism, giving "mass" to the ring.

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When the hand traverse is operating, pressure on the bar of the handle of the rotating mechanism disconnects the motor M -5A from the rotating mechanism and simultaneously with this the movable contact breaks contact with the contact ring (the "mass" is disconnected from the whole electric drive).

- (f) The gun commander's signal lamp is situated on TCU-20-A.
- (g) The fuel supply tumbler on the tank commander's button, is situated on the turret cover behind the tank commander.

The supply of the power circuits of the electric drive is from the safety fuse 250A in the accumulator protection block through VKU and filter FG-57 in the turret. The supply for the controlling circuits of the electric drive comes from fuse No. 2 on 20A in the turret panel.

III. Order of operation of the electric drive and commander's control system

1. Before starting the electric drive, release turret catches and ensure that there is no obstacle to rotation (turn the turret by means of the hand drive for 30 to 40 thousandths).
2. Warn people in the tank of the intention to rotate the turret.
3. To direct the electric drive from the position of the gun commander, press by hand the lever of the controller (KB-4) handle and turn the handle in the direction to which the turret must be turned. The speed of rotation of the turret increases with an increase in the angle of turn of the handle.

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A smooth increase in the speed of rotation of the turret is effected when the controller handle is turned to an angle of up to 40°. If the handle is turned to a great angle causes a switch of the motor MPB-54 to supply from the accumulator battery and from this the speed of rotation of the turret rises sharply to the maximum.

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4. To control by the electric drive from the tank commander's position connect (switch on) the commander's control tumbler-switch, release catches on the commander's hatch and turn, directing the sighting instrument on to the target. Keeping the sighting instrument on the target, press the tank commander's button. When the turret stops, release the button.

To obtain electric braking of the turret when the gun is going for the target, when controlling by electric drive from the tank commander's position, the lever of the controller handle must be released, while the handle of controller KB-4 must be in a neutral position.

GUNNER! When the signal lamp goes on, situated on "TSh", immediately cease controlling by electric drive and hand drive the rotation of the turret.

5. On completing the operation, disconnect the commander's control tumbler-switch and fasten the commander's hatch. In doing this the roller of the terminal switch block handle PC-3, having rolled around the copying (?) installation must enter the radial recess of the copying installation. If the handle roller does not enter the recess mentioned then release the catches of the hatch cover, turn to one side and the other on a small angle in a relatively neutral position and then re-fasten the hatch catches.

After this the handle (lever?) roller will certainly enter the copier copying device recess.

6. When dismantling the terminal switch block PC-3 and in its subsequent assembly, it is essential to carry out the following:

When the cover of the commander's hatch is fastened up the roller of the terminal switch block must be in the radial recess of the copying device with a clearance of 0.2 to 0.5mm between the side walls of the copying device recess and the roller. The clearance is adjusted by moving the bracket (arm?) of the terminal switch block.

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In this connection the size of the angle of insensitivity of the commander's control must be within the bounds of 6.8 to 10.2mm in linear measurement, measured on the internal surfaces of the runner of the commander's hatch. The size of angle of insensitivity of the commander's control is adjusted by measuring the gap between the cog (cam) on the lever of the terminal switch block and the rollers of the rods of the terminal switch by screwing or unscrewing these rods or adjusting washers between the fastening clamps of the terminal switches and brackets, to which they are fastened.

COMMENT: By angle of insensitivity is meant the angle of turn of the commander's hatch cover in one or the other direction from the original position (the hatch being fastened) until the moment of contact of one or another of the terminal switches. The moment of contact (switching on?) of the terminal switch is determined by the commencement of rotation of the turret.

Structure and operation of the locking device of the Electric drive from the driver's hatch

1. Purpose

The locking device of the electric drive from the driver's hatch is designed to exclude the possibility of the turret being rotated by the electric drive while the driver's hatch is open.

2. Structure and Operation

The locking of the electric drive from the driver's hatch is effected by breaking minus (negative?) circuit of the electric drive with the help of switch

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PC-3, positioned on the socket of the mechanism for closing the hatch and a special copying device (?) welded to the bracket closing the hatch.

When the driver's hatch is closed, the rod of the switch PC-3 is to be pressed out by the copying device (?) to its extreme upper position. In this position the minus (negative?) circuit of the electric drive is closed which ensures the possibility of rotating the turret by the electric drive.

Page 108 When the driver's hatch is open the rod of the switch is the extreme lower position the minus (negative) circuit of the electric drive is disconnected and rotation of the turret by means of the electric drive is impossible.

COMMENT: On the removal and subsequent replacement of switch PS-3, it is essential to position the switch in such a way that when the hatch is open the clearance between the switch roller and the face of the socket nut is 3 to 4mm.

V. Maintenance of the Electric Drive

REMEMBER! Only careful maintenance of the electric drive will ensure its effective operation.

1. Regularly check the effectiveness of the electric drive assembly fixtures and connecting leads and, if necessary, tighten up.
2. Regularly clean dust, dirt and oil from the electric drive assembly.
3. After every 100 hours of use inspect the commutator and brushes of motor MPB-54 and motor generator AB-54 and, if necessary, blow through the collector and brushes (with bellows).

Should the collector be dirty, rub it with a clean rag lightly damped in benzine; if the collector is badly scorched clean it with sandpaper (glass paper?) No. 00 and then rub it with a rag damped in benzine.

4. Regularly clean dirt, dust and oil from contact rings and brushes in the commander's hatch and in the turret rotating mechanism.

5. It is forbidden for the crew to open, dismantle and adjust the electric drive assembly.

The repair of faults in the electric drive assembly must be carried out by an experienced electrician.

6. TAKE CARE OF ACCUMULATORS! Except of extreme necessity do not switch on the electric drive when the engine is not working.
7. Unless essential, do not rotate the turret during one process, more than one full turn.

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Regulating Driving Control

1. Adjustment of the drive to the fuel pump, a correctly adjusted drive must answer (meet) the following requirements:

1. When the pedal is pressed until the limiting (stop?) bolt reaches the floor or in maximum reverse gear, with the hand throttle handle providing additional feed, the engine running idle (without load?) develops its maximum number of revolutions (2,000 to 2,200 revolutions a minute).
2. When the pedal is released and the hand throttle handle put into the forward (to the nose of the vehicle) position, the engine should stall.

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The adjustment of the drive and the testing of the adjustment must be done in the following way:

1. When fuel is being supplied to the maximum, i.e. when the pedals are fully in play, the clearance between the rod lever of the fuel pump and limiter (stop) on the pump itself must be from 0.1 to 0.2mm. The pedal stop bolt should rest against the floor at this point. The measuring of the clearance is effected through the hatch on (over?) the air cleaner (with the latter removed) with the help of a special gauge, contained in the individual kit.
2. The movement of the small arm of the movable lever, fixed to the face surface of the engine crank case (from the transmission side) should be evenly (to an exactitude of 2mm) divided to the left and to the right from the vertical axis of its rotation.
3. When fuel is being supplied to the maximum the large arm of the lever fixed on the left side sheet, should not move across more than 2mm beyond the vertical axis of its rotation on the side of the nose of the vehicle.

The actual adjustment of the drive is done by changing the length of the shafts with the help of the forks on them.

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4. After final adjustment and testing it is essential to fix the shafts, and split pins, grease the axes and hinge joints and confirm that the drive operates easily (without sticking). The forks must be screwed on the shafts at a length not less than 12mm (testing is done by the openings in the shafts).

II. Adjustment of the drive to the main clutch

The adjustment must be carried out in the following way:

1. The press(?) of the clutch should be within the limits of 6.5 to 7.5mm and is controlled by moving the carrier box in relation to the flange of the socket cover of the primary shaft KPP.
2. The free play of the longitudinal shaft, going along the side, should be 7 to 9mm and is adjusted by changing its length.
3. The minimum permissible free play of the longitudinal shaft is 3mm. With a smaller amount of play it is necessary to remove the pressure disc, and then to remove one washer of thickness of 0.5 mm from each pin of the main clutch spring.
4. The tension of the servo springs of components of the main clutch are adjusted by tightening the nuts on the links of the servo springs in the following order:
 - (a) Press the pedal until it stops against the forward sloping plate and tighten the servo spring (to the whole extent of the threads of the links). If in doing this the pedal returns unevenly (in retarded fashion) to the limit presented by the screw in the initial position, release the servo-spring until the point where uninhibited return of the pedal is obtained.
 - (b) Tighten the nut on the link to the limit.

III. Adjustment of the Gear Adjustment and testing of adjustment must be carried out in the following order

When full engagement and correct neutral positioning of any gear takes place, when link carriers are switched, the indicator arrows on the switch shafts of the boxes (shafts of the box switches?) must coincide with the graduation lines on the crank case boxes, determining the neutral or connected "at speed", position of the drive.

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An error (shortage?) of position engagement, of up to 1.5mm, is only permissible in first speed and in reverse gear.

If the arrows do not coincide with graduation lines on the crank case, which indicates that the gear is not properly positioned, it is necessary to

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change the length of the short rods of the vertical shaft with the help of the forks, until the arrows and graduation lines coincide.

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With a correctly adjusted crank (link?) lock, the latter may occupy the following two positions:

- (a) The cable handle not being pressed to the lever - the crank lock is overlapped (covered?) by the locator catch.
- (b) The cable handle being pressed to the lever - the crank lock is turned and the apertures in the lock coincides with locator catches. If the checking mechanism of the crank has become maladjusted - it is essential to change the tension of the cable, screwing or unscrewing the regulating bolt on the crank case.

If the cable has become very stretched - it must be shortened.

IV. Adjustment of control gears of planetary rotating mechanism and brakes

Correct adjustment of control gears is ensured by:

1. Absence of contact between brake linings and drums when the driving (gear) levers are in the initial (starting?) positions.
2. Precise location of driving (gear?) levers in the first position, corresponding to braking of the small drum. In this, there must be a clearance of 4 to 5mm between the lever roller of the small brake and the recess of the distributor cam, while the lever roller of the locking clutch must enter the lunge (socket) of the distributor cam, which corresponds to the full disengagement of the clutch. The axis play of the movable cup of the clutch is 3.3 to 5mm, and in this the large stopping drum must be released (unbraked).

The springs should closely stretch the small brake lining on the drum.

3. In the second position of the gear lever the large stopping drum is tightened, and small drum is released.
4. The return of the driver's lever from second to first position should be effected by means of a light push of the hand on the lever.

To regulate the driving gear it is essential to:

1. Disconnect the rear short driving shaft (rod?) of the locking clutch PMP from the bridge lever and push it back by hand, in doing this the roller must be closely pressed against the cam and the lever of the transmission? (crossover?) shaft flush with the adjusting bolt on the bracket. The free play (idling?) which is obtained should be within the limits of 6 to 8mm. With free play of less than 6mm it is necessary to shorten the rod by screwing the forks; with free play of more than 8mm, do the reverse.

After this, the rod must again be connected up with the lever.

2. Join the rear short shaft (rod?) of the small brake PMP to the brake lever by means of a fork, in doing this the small lever of the brake must be in the lowest possible position while the PMP roller must be on the top of the distributor cam. The clearance between the brake linings and drum must be between 0.8 to 2.5mm and is adjusted by the nut of the brake lining tightening bolt. With a taut small brake the clearance between the distributor cam and roller must be 4 to 5mm. The aperture is, again, adjusted by the nut of the brake lining tightening bolt.

The clearance between the roller and distributor cam must be measured with a tightly stretched brake lining on the drum of the small brake while the transmission is moved.

The correctly regulated clearance between the roller and distributor cam must be marked by arrows, put on the brake bracket.

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The coincidence of the arrows must correspond to a normal clearance of 4 to 5mm. The adjustment of the stopping brake is effected by the nut of the

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tightening bolt and is controlled in the driver's section in the general play of the shaft, which must be 135 to 150mm.

With a correctly adjusted drive when the parking brake is pressed both linings tighten simultaneously (i.e. the movement of the brake linings begins simultaneously).

DRIVER! 1. Check the clearance between brake linings and drums in good time - by this you will ensure easy and effective driving of the tank.

2. If the pedal of the main clutch is caught (does not return to the original position) quickly release the servo spring.

SPECIAL APPLIANCES AND INSTRUCTIONS FOR USEEquipment

Appliance for dismantling gun system DIO-T (fig 13)
Working principles and rules for use

I. General description

With the help of the appliance in question the system can, in case of necessity, be changed without removing the turret.

The dismantling and assembly of the system without removing the turret is made possible because the stern portion of the turret is raised to an extent necessary for creating the appropriate distance between the turret and decking. The nose portion of the turret remains, at this time, in its position, rotating only around a special joint (28.273sb-2 and 28.274sb-2), which is part of the appliance. The raised portion of the turret is held in a tilted position by two bars (28.269sb-1 and 28.270sb-1), the lower ends of which are joined by hinges to the roof of the body, while the upper ends are propped against the stern of the turret.

When rolling out the gun system is stacked on a metal sheet (28.724), moving on four tube-rollers (28.723-1), which in their turn run on two beams (28.725), laid along the body. The raising of the stern portion of the turret can be effected by any transport-hoisting crane with a hoisting capacity of not less than 5 tons.

II. Assembly of the appliance. Raising of the turret.
Dismantling and removing the gun system.

The work of assembling the appliance and dismantling the gun system is conducted in the following order:

1. Before setting up the appliance, remove;
 - (a) The file (saw?) from the roof sheeting beneath the turret.
 - (b) The four plugs on the roof of the hull (to the right of the driver's hatch, the apertures of which are used fitting struts (?) (28.273sb-2 and 28.274sb-2.)

Page 115: Sketch: Appliance for Rolling Out (Removing) the System

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- (c) Armoured mask (?)
- (d) Unscrew the six fixing bolts of the lower turret ring (the bolts are used for fixing the strut brackets to the walls of the turret embrasures).

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2. Position the struts 28,273sb-2 and 28,274sb-2 in front of the turret (four bolts for fastening are contained in the company kit).
3. Remove the remaining bolts fastening the turret ring to the body of the vehicle.

COMMENT: The bolts which are removed are to be numbered so that on assembly they will return to their own positions.

4. Remove the gun system aiming sight from its bracket.
5. Remove from the turret the tarpaulin covering the machine and the driver's shield.
6. Remove the co-ax machine gun (the removal of the machine gun's bracket is not essential).
7. Remove the shields which protect from the penetration of lead spray.
8. Remove the switch (disconnecting) lead of starter VS-11 and tension relay RT-9.
9. Disconnect the leads from the system. Disconnect the lower leads VKU.
10. Remove all ammunition to be found in the turret.
11. Unscrew the fastening bolts of the forward sectors of the runner guards, one by one, to the right and left from the system.
12. Remove the convertor.
13. Remove the hoisting mechanism of the system (when removing the mechanism it is essential to ensure that washers are not lost).

COMMENT: To ensure the removal of the hoisting mechanism it is essential to remove in advance: the controller, the starter switch device with (from) bracket and motor generator.

14. Remove the system's compensatory mechanism (springs),

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15. Remove seat brackets: the gunner's commander's and loader's.
16. Remove and extract from the turret all that which might hinder the rolling out of the gun system. Unscrew the fastening bolts of the two hatches (situated on the floorbottom of the cupola) and remove the cover.
17. Remove the fastening bolts of the pivot axis and move out the bushes leaving 10 to 15mm of the body of the bushes in the bracket of the system.

COMMENT: It is not essential to ensure the strict consecutive sequence of the tasks in point 4 to point 17 inclusive.

18. Raise the turret by the rear hooks (on the turret) to a height of 150 to 200mm to allow for the removal of the six bolts in the decking over the motor and the placing of a rod and slabs (bricks? blocks?) to the right and to the left on the cover over the motor. (The six bolts for fixing the slabs to the decking are contained in the company kit).

In conducting this operation it is essential to place under the bottom of the turret two logs of 150 to 200 in diameter(?) and a length of 500mm.

COMMENT: In raising the turret the hoisting cables should be arranged so that they do not bend the bracket on which the D Sh K is installed (the D Sh K store bracket?) whilst on the move.

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19. Raise the turret to an angle of 25 degrees and put the right and left rod in place. The ends of the rods to be put into the hatch apertures, situated on the bottom of the cupola and fasten every rod with bolts as in fig. 13.

The effectiveness of the fixing of the turret by these devices to be tested by rocking the turret on the gun barrel with slightly eased hoisting cables. A skewing of the turret is not allowed.

20. Lay out the floor (the bridging) in the following way: lay out two beams (28.725), joined together by two couplings (28.236sb). Beneath the beams lay wooden planks-linings (as shown on the sketch)..

Lay four tube-rollers (28.723-1) on the rollers, and on these place the metal sheet (28.724).

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21. Raise the system by the barrel and wind it fully until the shield of the system comes up against the supporting sheet, and then lay the wooden linings (buffers?) between the supporting sheet and the shield (see sketch).

22. Raise the system by the barrel and remove from the bushes the pivot axes (knock out the bushes).

23. Carefully roll out the system. According to the distance the system emerges from under the supporting sheet the last tube roller should be removed and transpositioned. When the gun system is being removed the vehicle may be moved slowly in first speed (gear?).

COMMENT: On fig. 13, the rolling out of the gun-system is shown with (the use of) the shield and cartridge case-collector. The gun-system may be removed without the shield and cartridge case collector.

III. The Assembling of the gun system

The work is done in the following order:

1. The system is put on the wooden linings, set out to size - 180mm on the supporting sheet and is rolled under the turret until the pivot axes of the system coincide with the pivot axes on the turret bracket.

When assembling, as with dismantling, the tube-rollers are transpositioned.

The rolling in is done with the help of hoisting tackle or the slow movement of the vehicle in reverse gear may be used.

2. Raise the gun-system by the barrel, by manipulation (?) arrange the bushes of the pivot axes. Screw up the bolts and split pin them.

3. Remove the flooring (bridging).

4. Remove the upper fixing bolts of the rods to the floor of the cupola. Raise the turret, remove the right and left rods and blocks.

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5. Position the six fixing bolts of the cover over the motor (engine?).

6. Slowly lower the turret, at the same time two persons inside the vehicle must observe and ensure that the threaded apertures in the lower turret ring meet the apertures in the roof of the body.

To simplify this task use is made of the conical part of the pawl (rod?) intended for joining the sections of caterpillar tracks.

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The apertures in the lower turret-ring in the specified position of the turret, must coincide with (any?) two of the apertures in the roof of the body, situated at a distance of 500mm near the engine guard.

7. Place two fixing bolts of the lower turret ring in the central apertures, and then all the remainder, tighten the bolts fully and then split pin them.
8. Remove the right and left struts: 28.273sb-2 and 28.274sb-2.

In the apertures of the four bolts fastening the struts to the body roof, place four plugs.

9. Conduct a full assembly in side and outside the vehicle in any desired order.

COMMENTS: 1. In fitting the old gun-system it is essential to replace all previous washers on the elevating mechanism.

2. After fitting the gun-system it is necessary to test the sight and bracket of the co-ax machine gun on a target.

The supply and replenishment of the system DIO-T with fluids and air (is effected with?) pump 52 and 035 (pump NVG see fig. 39). Pump 52 and 035 for supply and replenishment of the DIO-T system are placed in position on the hatch covers of the forward fuel tank. To position the pumps it is necessary to unscrew both bolts used for fastening the cover, then remove the hatch cover of the forward fuel tank. The bolts which have been removed to be used for fixing the bracket of the pump item 54-28 1050 (see fig 39).

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In the reinforced control (guiding?) bracket set pump 52 and 035. Join the hoses. All the necessary tasks with the system and the pump to be carried out according to the instructions given with every pump. The instructions are contained in the box where the pump is stored.

COMMENT: The pump and bracket are contained in the operational kit.

The Engine

Changing the Exhaust Pipe and packing the exhaust.

To ensure access to the exhaust pipes when dismantling them it is necessary to:

1. Remove the cover on the radiator, the radiator and the cover on the engine (the fluid from the cooling system to be removed in advance).
2. Remove the ventilator of the combat section together with the bracket and oil radiator (it is not necessary to remove the oil from the oil system).

COMMENT: When measuring the exhaust packing without dismantling the exhaust pipe the engine cover and water radiator need not be removed.

I. Dismantling the exhaust pipe and exhaust packing

1. Remove the durite (?) hoses which join up the ejection pipes.
2. Remove the exhaust packing from between the manifold and the exhaust pipe.
3. Remove the exhaust pipes and carefully clean the flanges on the side and the exhaust collectors, and also the flanges of the exhaust pipes if the latter are to be replaced - removing soot and carbon deposit.

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II. Fitting the Exhaust Pipes

1. Fit the exhaust pipes with a copper-asbestos lining (washer?) to the side, by means of the upper flange.

2. Fix device 28.245sb on the lower flange of the exhaust pipe, as shown in fig. 14 and then by packing washers between the claws of the exhaust pipe and
Sohkamu? ... on the side for fastening them, and also placing two copper-asbestos linings (washers?) between the side and upper flange of the exhaust pipe, achieve parallelity of the lower flange of the exhaust pipe with the manifold flange. A curving of not more than 1.5mm, after the bolts have been fully tightened, is permitted. Under one claw of the exhaust pipe it is permissible to place not more than 3 washers of 1 to 3mm thickness.

COMMENT: In fitting new pipes the gap in the fastening claws of exhaust pipes may be sawn (down?) to 2.2mm and the gaps (apertures?) in the upper flanges to 1mm.

III. Exhaust Packing (fig. 15 and 16)

1. Place the packing ring 06.057 and flange 06.085-2 on the bush 06.059-1 (previously setting the ring catch (lock?) in the opposite direction).

To ensure that the flange 06.085-2 is aligned in relation to the bush 06.059-1 (ensuring that the clearance "a" on fig. 16 is not less than 1.5mm) it is recommended that a cardboard strip of 1.8 to 2mm be laid on.

2. The packing of the asbestos string to be carried out in accordance with the sketch on fig. 15. In doing this the asbestos cord is to be wound on to item 06.059-1 in even, circular turns. The asbestos cord must be dry and clean. The amount of cord: 60 to 70 grams, its diameter: 4-6mm. The tightening of the nuts, with the pressure on the asbestos of a supplementary flange is to be done in an orderly and even manner without allowing any bends. After the asbestos has been pressed in, remove the supplementary flange and washer 06.22sb and adjust the asbestos in such a way that it evenly fills the whole space of the recess in the flange and does not intrude on to the face of the flange.

To remove gaps it is permissible to fill them with asbestos cord. After adjustment the asbestos must again be pressed in the same manner.

Page 123: Sketch: Packing Asbestos cord during Exhaust Packing

Page 124: Sketch: The Joining of the Exhaust Pipe with the Exhaust manifold

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To remove the possibility of distortion in the components it is advisable, during the second "pressing" to change over the two washers 06.22sb (the upper one to be put in the place of the lower). After the second pressing of the asbestos remove the supplementary flange, the washers 06.22sb and one upper, copper washer 06.086-2. The remaining copper washer must be approximately level with the surface of the flange and the asbestos must protrude above the surface of the flange for 1 to 2.5mm, as is shown in fig. 15.

COMMENT: When tightening the bolts, to avoid possible constriction of the flanges (06.085-2) with the bushes (06.059-1) it is necessary periodically to press the flange down on the bush.

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IV. The arrangement of packing the exhaust of the machine (fig. 16)

1. Assemble two copper-asbestos gaskets 06.15sb-1 and fix the exhaust packing, in assembly, to the flange of the exhaust pipe. (Clearance "S" must not be less than 2mm in any place in the circumference).
2. Position regulating (adjusting?) washer 06.090 with the copper asbestos washers (lining?) in such a way that the catches (scarves) (folded ribs (?)) of the washers are directed towards the side. Position and tighten the fixing bolts of the exhaust packing to the flange of the exhaust collector. The tightening of the bolts to be carried out gradually and evenly, to the full, over the area (circumference?).
3. Remove the cardboard strip (if centreing has been carried out by cardboard) and with wire Ø1.5 to 1.6mm check clearance "a". The wire must go through the whole circumference.

COMMENT: If necessary, clearance "C" (=S) is checked in the following way. The exhaust packing, without copper-asbestos washers 06.23sb is held by bolts with washer 06.09-0 to the flange of the collector with bent wire Ø2mm. Clearance "C" is measured. The wire must go freely through to the whole circumference. It is advisable to place a standing (?) protruding (?) setting (?) ring - 06.105 on the end of bush 06.059-1 as is shown in fig. 16. If the rubber setter (washer?) is of less than 3mm thickness cardboard to be put under the setter (?). In making item 06.105 from cardboard, the latter is to be put on the bush on whiting (white lead). In fitting item 06.105 clearance "C" is not subject to control (?)

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Note: Setting ring (?) seems from context to be a rubber washer

V. Fitting removed components and turning over of engine

After completion of the fitting of the exhaust the components which have been removed are to be replaced and the engine turned over.

The turning over of the engine is to be done in all its performances, the first 10 to 15 minutes on minimum revolutions. There should be no flow of unrefined (crude) fuel or bursting out of gases from beneath the washers and packing (gasket?) rings.

- COMMENT:
1. When replacing components, previously on the machine, they must be carefully washed in gas oil or kerosine and wiped with a rag. In fitting new components they should be cleaned of the preserving lubricants on them.
 2. Copper-asbestos linings (washers?) must all be changed for new ones.

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Replenishment of the system with water, oil and fuel

1. Replenishment with water

1. The replenishment of the cooling system is to be conducted through a special funnel with sieve carried in the tank's ZIP. In doing this the vehicle must be positioned horizontally (to the eye).
2. For the replenishment of the cooling system it is advisable to use clean, fresh water (tap, rain or river). The total amount of water which goes into the cooling system consists of about 80 litres. Mechanical adulterations, contained in the water, obstruct the pipes, radiators and engine cylinder linings and lead to local over heating.

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Salic adulterations facilitate the development of scale, impair heat circulation and cause overheating of the engine.

3. It is recommended that water be added to the cooling system and not changed entirely.
4. Replenishment with unheated water to take place down to an air temperature of +5 degrees centigrade.
5. The replenishment of the cooling system in winter conditions (with an air temperature of less than +5 degrees centigrade) to be carried out in accordance with section "Use of the Heating System" in these instructions.
6. REMEMBER! In the summer operational period the replenishment of the cooling system and its draining is to be carried out with the heater disconnecting tap on. After replenishing the system the tap handle is to be turned to the "off" position.
7. After replenishment of the cooling system in the summer period it is essential to turn over the engine for three minutes, after which the system should be topped up.

With a fully replenished system the level of water in the filler throat (opening?) must reach the beginning of the threads for the plug.

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II. Replenishment with Oil

1. The replenishment of oil in the tank is effected through a meshed filter in the filling opening of the tank with the help of a special funnel, supplied in the ZIP.
2. For replenishment of the oil system in winter and summer use different types of lubricant according to Section VI: "List of fuel-lubricant materials of special fluidity used in a tank", of this instruction.
3. The replenishment of the oil system must be carried out only with clean and laboratory tested oil from a sealed container.

Dirt which finds its way into the oil system causes increased wear of the engine parts and premature defectiveness.

Oil to be poured into the oil tank to the level of the red mark on the gauge, which is equivalent to 60 litres.

The checking of the oil level in the tank to be carried out with a full oil system. For this the engine should be run, preliminarily, for 3 minutes. If necessary, after running the engine the oil in the tank should be topped up or drained.

Measuring with the gauge to be conducted in such a manner that the gauge touches the forward wall of the oil tank and maintains an approximately vertical position (see fig. 1a).

4. In winter conditions, i.e. with air temperatures of less than plus 5 degrees centigrade, the oil tank is to be replenished with oil heated to a temperature of plus 80 to 90 degrees centigrade.

III. Replenishment with fuel

The replenishing pump, as a basic official item, is intended for the rapid replenishment of oil tanks with simultaneous filtration of the fuel through a silk linen (gauze cloth?). The replenishing pump is situated in a special box situated on the right shelf of the tank.

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checking oil level in oil tankPage 130Maintenance of Air Cleaners

1. Cleaning of air cleaners to be carried out after every 1,000 kilometres of running of the tank.

In winter conditions, when there is snow on the ground the cleaning of air cleaners need not be carried out.

2. The air cleaner cassettes are to be washed in clean diesel fuel in a special little bath contained in the operational kit.

The cassettes may be washed in any clean container, holding a sufficient quantity of diesel fuel.

3. In the servicing of the air cleaner it is essential to act in the following way:

- (a) Unscrew the clamping nuts for a few turns, remove the cover of the air cleaner;
- (b) Unscrew the cassette fastening bolts for a few turns, remove the cassette fixing bars;
- (c) Remove cassette(s?);
- (d) Clean dirt from the internal surface of the air cleaner head and cover and wipe with dry clean waste rag or cloth;

Do not allow waste rag, cloth or other extraneous articles to fall into the trough of the air cleaner;

- (e) All felt washers (linings) to be carefully cleaned of dust and dirt and greased with lubricant USS-2 (see list G.S.M.);
- (f) Each cassette to be washed separately and carefully in diesel fuel. During the washing process the diesel fuel is to be changed.

If compressed air is available it is advisable to blow over (through?) the cassettes after washing.

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- (g) After washing, the lower cassette is to be impregnated with diesel fuel and the upper and middle cassettes with oil MT-16P. After washing allow surplus oil to run off.

COMMENT: To increase the speed of the process of running off the oil it is essential:

- 1. That the oil be heated to its greatest temperature and also that the flowing off process be conducted in a high air temperature.
- 2. With a temperature of the surrounding air of plus 15 to 20 degrees centigrade the period taken for oil to flow off, depending on its own temperature, will be as follows:

Temperature of Heated Oil in degrees	+60°C	+80°C	+100°C
Time taken, in hours, for oil to flow off	2	1.5	0.5

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3. Position the cassette at an angle of approximately 45 to 60 degs.
 - (h) The cassettes, prepared as above, to be placed in the air cleaner and fastened with fixing bars. The opposite ends of each bar should enter the pockets at approximately the same size. Before fitting the cassette it is essential to check the correctness of seating of all packing washers (linings) in their seats.
 - (i) Fit the cover and tighten it fully to the head (cap) of the air cleaner, tightening the clamping nuts.

Starting the engine in summer

Before starting the engine its readiness for starting should be verified. This should be done in the following sequence:

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1. Check the level of fuel, oil and water.
2. Ensure that there are no leaks in the fuel, oil and water pipe joints of the machine and engine. Also check the free-movement of levers (arms?), joined to the casing (?) of the fuel pump.
3. Check the air pressure in the cylinders which, in summer must be not less than 40 atm.
4. Check the junction of the suction collectors with the air cleaner.
5. Do not start the engine until all faults and defects have been corrected.
6. The engine may be started by two independently operating methods: by electric starter (motor) or by an air starting device. The basic starter fitting is the electric starter. The air starting device is a reserve method.

Page 133.1. Starting by means of the Electric Starter

1. Ensure that the knob of the hand control for fuel supply is positioned for disconnection of supply.
 2. Engage the switch of the "mass".
 3. Place the handle of the fuel distributor tap in the operating position, connecting up any group of fuel tanks. In the first instance, exhaust the external fuel tanks.
 4. Release air from the fuel system. To do this it is necessary (having opened for 5 to 10 seconds the air outlet tap situated on the cross beam of the body) to pump the fuel with the hand pump.
 5. By brief (3 to 5 second) periods of pressure on the button of the electric oil pump, create a pressure oil in the system of not less than 3 atm. Then release the button and for 3 to 5 seconds press simultaneously on the electric oil pump and starter, in this way rotating the crank shaft a few times with supplying fuel.
- REMEMBER! The electric oil pump may be held in the engaged position for not more than one minute.
6. Confirm that the KPP crank is in the neutral position.
 7. Press the main clutch pedal to the full.
 8. Put the fuel supply pedal into a half-pressed position.
 9. Press the electric starter button for 2 to 3 seconds.
 10. As soon as the engine starts, release the electric starter button and smoothly release the main clutch pedal.

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11. Establish the minimum steady revolution of idling (700 to 800 revs per minute) and fix the position of the fuel supply pedal by the hand throttle 50X1-HUM

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Immediately after starting it is not advisable to allow the engine to develop more than 700 to 800 revs per minute.

12. With an air temperature of less than plus 5 dgs centigrade it is forbidden to start an engine which has been standing, without prior pre-heating.

II. Starting by means of the Air Starter Device

1. Make preparations for starting as is described in lines above, 1, 3, 4, 5, 6, 7, 8 para I ("Starting by means of the Electric Starter").
2. Open the air cylinder valve.
3. Quickly open the by-pass (passage?) tap.
4. As soon as the engine starts, shut the by-pass tap and cylinder valve and smoothly release the main clutch pedal.

During the period of air passage the air pressure reaching the air distributor must not be more than 90 atm and not less than 40 atm.

5. Stop the engine, as described above in points 11 and 12 of para I "Starting by means of the Electric Starter".

III. Warming-up the Engine

1. After starting it is necessary to follow the instrument readings.

In the first minutes of engine running the oil pressure is usually appreciably higher (particularly in winter) than after warming-up.

After starting, the oil pressure must be not less than 2 atm on minimum steady rotation. If the instruments show an insufficient oil pressure, the engine must at once be stopped and the cause ascertained.

2. After starting the engine should be well warmed up so that the water and oil should heat to the appropriate temperatures.

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3. The warming-up of the engine after starting should be done gradually and steadily in free running (idling) at a rate of 700 to 800 revs a minute, with a gradual stepping-up to 1200 to 1600 revs a minute until the temperature of the outflowing oil and water reaches plus 40 degrees centigrade. When this temperature has been reached the vehicle may be put into motion in low gears.

The engine may be loaded (?) only after it has been warmed up.

The engine is considered warmed-up and ready for normal use in all gears when the temperature of outflowing water and oil is plus 55 degrees centigrade.

4. The starting of the engine in winter conditions must be done in full conformity with the instructions in section: "Use of the pre-heating system" in this instruction.

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X. Adjusting the co-ax mounting for normal fire (combat?) with the aid of a control-testing target (without ranging fire)

With the aid of a control-testing target only those machine guns can be adjusted for normal fire (combat?) as have in their log books a control-testing co-ordinate. The order of adjusting is as follows:

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1. At a distance of 40 metres from the muzzle opening of the machine gun place a board with crossings marked on it in accordance with the control-testing co-ordinates.
2. With the aid of the aiming mechanism co-relate the central square of the sight T Sh with the square on the board.
3. Conduct observation through the T Kh P (Cold Ranging Pipe) situated on the barrel bore of the machine gun (or through the barrel bore) and if the crossings of the T Kh P coincide with the crossings on the board then the machine gun is in a condition, adjusted to normal firing (combat?).

If the crossings do not coincide then it is essential to adjust for the co-relation of the crossings with the help of the testing mechanism of the machine gun.

COMMENT: When conducting observation through the machine gun barrel (instead of the T Kh P) it is essential (without removing the machine gun) to disconnect the plug joint, separate the back plate and bolt, remove the moving parts of the machine gun and place in the cartridge chamber an empty cartridge case with a small aperture in the centre of the cap. If, when this is done, the crossings on the target are visible in the centre of the barrel aperture then the machine gun is in a condition, adjusted for normal firing (combat?). If this is not so then it is necessary, with the aid of the testing mechanism to adjust the machine gun in the direction of the crossings on the target.

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XI. Adjustment of Anti-Aircraft Mountings D Sh K for normal firing (combat?) with the aid of a control-testing target (without ranging fire)

With the aid of a control-testing target only those machine guns can be adjusted for normal fire (combat?) as have in their log books a control-testing co-ordinate. The order of adjusting is as follows:

1. At a distance of 40 metres from the muzzle opening of the machine gun place a board with crossings marked on it in accordance with the control-testing co-ordinates.
2. In the barrel bore of the machine gun place a T Kh P (Cold Ranging Pipe) and with the aid of the aiming mechanism co-relate the crossing on the T Kh P with the crossing of the "D Sh K" on the board, after which the mounting is to be locked.
3. If on looking through sight K 10-T the crossing on the sight coincides with the "K10-T" crossing on the board, then the machine gun is in a condition, adjusted for normal firing (combat?).

If the required co-relation is not obtained it is then necessary, with the aid of the testing mechanism of sight "K10-T", to make the crossings coincide.

Note: The term used here

mawka is however, more likely to be a colloquialism of a chess pawn or draughts (checkers) piece.

XII. Maintenance and Use of "BDSL-5" on the Vehicle

1. Purpose and brief description

The fitting "BD Sh-5" (Large Smoke on the vehicle is designed for setting up a smoke screen.

On the vehicle 2 smoke "dischargers" are fitted (see fig 33) on the stern plate by the left and right sides of the body and the smoke outlet valve must be directed to the rear. Each discharger is fixed on a bracket by two steel

/bands

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bands, having an adjusting screw, and a mechanical lock (catch?). The mechanical lock (see fig 34) serves to eject the smoke discharging from the vehicle and is brought into action by a cable, leading to a lever (handle?) in the combat section, fastened to the sides (left and right).

The lock consists of a body (frame?), pawls, rotating on an axis, a catch to which is joined the cable, of a fabric covering to protect the lock from dirt and dust.

"BD Sh-5" is brought into action by the ignition of electric fuses screwed into the discharger, by engaging a button positioned on the "BD Sh-5" panel situated on the left side by the engine guard.

The right button ignites the right discharger and the left the left. The branch boxes for the switching of the electric fuse leads of the "BD Sh 5" is situated on brackets, to which the dischargers are fastened.

The plan of the electrical equipment of "BD Sh-5" is on fig. 23.

2. Action of the BD Sh-5

The setting up of a smoke screen is effected by ignition of the electric fuse of the discharger on a moving or static vehicle or by dropping the ignited discharger from the vehicle.

The ignition of the BD Sh-5 is effected by the gunner or the vehicle commander by engaging the button.

The smoke screen can be set up simultaneously from both discharger or from each one separately.

To drop the "BD Sh-5" from the vehicle it is necessary to pull the cable by means of the lever situated on the sides (right and left).

The dischargers on the right side is ejected by the gun loader, on the left side - by the gunner or commander.

3. Maintenance

- (a) Before setting up the "BD Sh-5, check the condition of the band with (and?) screws and electric circuits, leading to the branch (junction?) box of the "BD Sh-5".

The lock and branch box must be carefully cleaned of dirt, snow or ice.

- (b) Check the workin. of the stop(catch?) and pawl.

When the stop is drawn out (?) the pawl should rotate freely on its axis. The action of the spring the cable from (?) the stop (catch?) should return to its original position. Before each journey it is essential to check the effectiveness of the fastening of the "BD Sh-5"

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INSTRUCTIONS FOR USING THE DIVING SUIT TU-1

DOCUMENT "H"

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Instructions for Using the Diving (Breathing) Suit "TU-1"**I. Purpose of the ("Hydro-overalls") diving suit "TU-1".**

The "TU-1" is meant:

- (a) to protect the diver completely from the water and to create favourable conditions for normal work under water;
- (b) to protect the diver's body from the cooling influence of the water;
- (c) to protect the diver from possible injuries by objects which he might meet while working under water.

II. The Construction and Main Parts of the Diving Suit "TU-1"

The "TU-1" is the main part of the light diving equipment.

It consists of:-

- (a) overalls with a helmet and face-guard, rubber boots and cuffs 1 piece.
- (b) rubber bands 2 pieces.
- (c) three fingered rubber gloves 1 piece.
- (d) rubber braids 2 pieces.
- (e) bag for keeping and carrying the diving suit 1 piece.
(See Fig. No.1).

The "TU-1" suit is made of a special rubberized strong material, impervious to air and water.

The other parts namely: helmet with face-guard, bands, gloves, braids, valves are made of a special elastic rubber.

In the top front part of the "TU-1" suit a rubber collar (called "Appendix") is fixed. It serves to put on the suit.

The sleeves have rubber cuffs which fit tightly round the diver's wrists.

Should the diver have to work in winter, or, in general, in low temperature of the air and water rubber gloves might be glued to the sleeves.

In the suit's shoulders excess air escape valves are fixed to draw the air out of the suit.

Special patches are fixed to the sleeves and trousers of the suit to protect knees and elbows.

These serve to strengthen those parts of the overalls which are mostly exposed to wear.

There are rubber boots solidly attached to the bottom of the suit's trousers. These boots protect the diver's feet from water, bruises and other injuries whilst he is under water.

In order to keep the diver steady special lead insoles, each weighing up to 2 kgs. may be put inside the boots. These lead soles are not included in the diving suit set.

The top part of the suit "TU-1" consists of the helmet with face guard, made of a special elastic rubber which insulates the diver's head.

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In the front part of this helmet-mask metal ringed glasses are mounted and a charging point with nut is fixed, leading to the valve box of the breathing apparatus. Inside the helmet a mouthpiece is fixed to the end of the charging point which the diver keeps in his mouth while breathing.

In the space adjoining diver's ears the helmet has rubber hemispheres with excess air escape valves and aerial canals connecting the hemispheres with the front part of the helmet.

The hemispheres and the canals are intended to adjust the air pressures in the outer part of the ear, the nasopharynx and to protect diver's ear-drums from excessive pressure as a result of the difference in air pressure.

III. Preparing Diving Suit "TU-I" for use by Diver

It is essential to remember that a diver's accident free working depends to a great extent on the proper preparation of the diving suit; therefore the following basic rules should be observed:

- (a) the diving suit must fit the diver's height;
- (b) it must in any case be thoroughly inspected and tested; this refers particularly to the seams, the material's state of repair mainly on the spots of maximum wear (Knees, elbows, groin, arm-pits). The state of the excess air escape valves must be thoroughly checked. No rubber roughening or other defects of the air escape valves should be allowed; their rubber must always be clean and elastic;
- (c) The mouthpiece and the face-guard must be carefully cleaned of dust and dirt and disinfected with alcohol.

IV. Maintenance and Keeping of the Diving Suit "TU-I"

On completion of the diver's work his diving suit must be carefully cleaned of mud, silt, grease spots, etc. It is therefore recommended to wash the entire suit with soap and fresh water. On the inside the helmet and boots only are washed.

Having thoroughly washed the diving suit one should hang it up in order to dry it and leave it so until the diver's next descent under the water.

The drying of the suit should be done in a shady place. It is strictly forbidden to keep these suits near heating apparatus.

The place where diving suits are kept should satisfy demands for keeping rubber goods; namely the temperature of the air should not fall below + 3° nor rise above + 20° centigrade.

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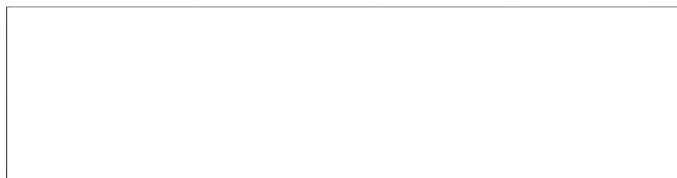
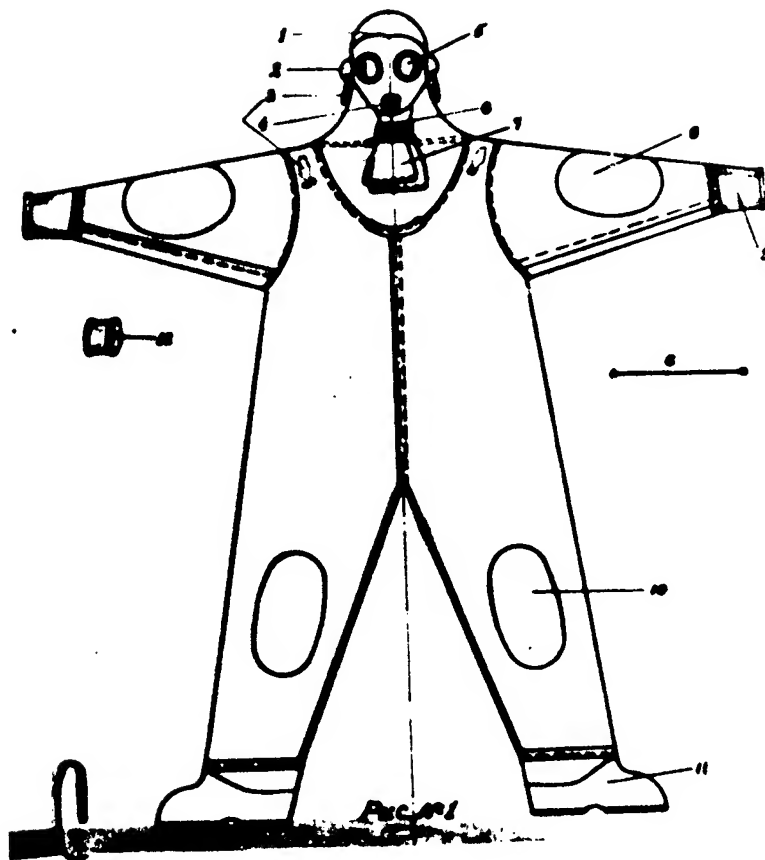
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FIG. 1



- 1. Helmet with face-guard
- 2. Rubber hemispheres
- 3. Excess air escape valves
- 4. Charging point
- 5. Glasses
- 6. Braid
- 7. Appendix
- 8. Elbow-protectors
- 9. Cuffs
- 10. Knee-protectors
- 11. (Ankle)-boots
- 12. Rubber band.

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